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METALOGRAPHY.

TEXT BOOK OF
METALOGRAPHY

(PRINTING FROM METALS):

BEING A
FULL CONSIDERATION OF THE NATURE
AND PROPERTIES OF
ZINC AND ALUMINIUM
AND THEIR TREATMENT
AS PLANOGRAPHIC PRINTING SURFACES,

By
CHARLES HARRAP,

Instructor in Lithographic Printing from 1886.
Medallist in Honours.
Board of Education Instructor in Inorganic Chemistry, Electricity, Magnetism, Sound, Light, Heat, etc., etc.

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PREFACE.

In presenting this little treatise on Metalography to the Lithographic Printing Trade, I have arranged the matter so that it deals with the subjects of zinc and aluminium in those phases which directly interest the actual worker, and have omitted as far as possible all details of lithographic printing which are well-known, or can be better treated in a work upon the whole subject. The contents of this treatise are, therefore, a section only of lithographic or planographic printing, and are complete in themselves.

I must apologise for introducing Chapter I upon lithographic stone; but it was felt that a discussion of the chemical actions which take place on stone, and are so well known to every lithographic printer, would form a good commencement for studying similar actions on the two metals. Chapters II and III upon aluminium and zinc are, therefore, very important to show the actual behaviour of these metals under similar and varying conditions to stone.

There has been no attempt to set down any one treatment in priority to others. All treatments have been chronicled, with special references to show which apparently give the more satisfactory results. But as all available methods have been dealt with, it is open to any worker to use them one by one until he finds that one with which he can produce the best results. The worker upon metals is invited to read the whole of the working details before commencing

to master any one of them, because little references are scattered through these pages which are equally applicable to any method adopted. One or two makes of plates of a coated character have been left entirely undescribed, but special plates and their treatment have been grouped in Chapter XIII.

In endeavouring to simplify the treatment of metals, Chapter XVI has been introduced to give at a glance the successive treatment of either zinc or aluminium for ordinary purposes. To any printer who knows the details this tabulation serves as a guide only, and to the beginner it sketches out the operations, the details of which must be gathered from the foregoing chapters.

Chapter XV has been given as a record of all known recipes, but in the general treatment of the subject sufficient references are made to show which of them are the more satisfactory. They have been placed in the order in which general experience would suggest. But as opinions and manipulation differ so much, the order there given is by no means arbitrary. The aim has been to uphold simplicity with efficiency, rather than elaborate mixtures. Every effort has been made to secure accuracy in every respect, together with simple working directions.

The proofs of this treatise have been carefully revised by numerous workers and chemical experts, amongst whom may be mentioned Messrs. J. Wilson, M.Sc., J. Crawford, and G. H. Block, to whom my thanks are due for their kindly assistance.

The proofs of various parts of the chapters upon special subjects have been submitted to Messrs. Furnival & Co., Linotype & Machinery Limited, Geo. Mann & Co., J. Ratcliff & Sons, R. Hoe & Co., Lanston

Monotype Corporation, Albert & Co., C. G. Röder, Ltd., Hunters Ltd., Penrose & Co., F. Horsell & Co., Algraphy Ltd., to whom my sincere thanks are due for their generous assistance in supplying blocks and details, and in revising the articles.

The title "Metalography" has been adopted instead of "Metallography" which might be objected to, as it is already used in the metallurgical profession with quite a different meaning; whilst in the records of the Patent Office it is used as expressing printing from metals.

As it is desirable that a record such as this should be accurate in historical as well as manipulative facts, readers are invited to favour the author with corrections which may seem desirable, before it is issued in further editions.

November, 1909. CHAS. HARRAP.

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INTRODUCTION.

In essaying to deal with the subject of printing from metals, it is not because there is any special novelty in the process to record, but rather to bring together the experience of numerous workers upon zinc and aluminium, all of whom have special qualifications for regarding them in the light of more than usually successful workers and investigators. It is unnecessary to say "that hitherto printing from metals has been more or less unsuccessful," because that is entirely beside the mark. The use of zinc as a printing surface is mentioned by Senefelder in his German work of 1818, and it is practically certain he had worked on zinc in 1817, if not sooner. He went still further, and produced zinc plates with coated surfaces. Such plates still exist, bearing Senefelder's own (manuscript) productions of music upon them, the drawing being of such an excellence as to indicate that he was a most painstaking draughtsman. It must further be admitted that plain zinc was experimented with, at least in England, from 1819, for in 1826 the following letter of H. Rowan, Leinster Street, to Captain Stisted, shows that some more than ordinarily plain work was then being produced.

Mr. Hamilton Rowan presents his compliments to Capt. Stisted. He at length sends a polished plate of zinc, which he has at this moment received from Mr. Grubb, in order to induce Mrs. Stisted to

exercise her pen or pencil on; to effect a more portable repository of drawings, and as he supposes from the enclosed sketch as permanent as those drawn on or transferred to stone. The drawing he sends was transfer and on a very ill-polished stone. This perhaps may have been in its favour, and would not be a singular instance of high polish destroying intrinsic merit.

LEINSTER STREET,
19th Aug., 1826.

There is little doubt that zinc was continually in use and has not at any period fallen into desuetude. In 1829 Breugnot of Paris printed large geographical charts from zinc. Between 1830 and 1840 zinc was used by Day & Son for railway views. In 1835 Chapman & Co., 20 Cornhill, published a drawing on zinc, by their "patent," in the *Railway Magazine* of May, 1835. Whether they really had a patent is somewhat difficult to say. And quite recently some chromo specimens have been exhibited with the imprint, del. et zinco, 1838. Again, the Ordnance Surveys were commenced in 1747, and improved in 1783. In 1797 the first map of Great Britain was put in hand. The survey of Ireland was ordered in 1824; and in 1840 Scotland and the Northern Counties were commenced. But in 1855 surveys were ordered on the 1 in., 6in., and other larger scales. The headquarters of the survey were at the Ordnance Survey Office, where it is well known that from an early date the 6 in. survey was printed from zinc. In fact it was probably used some years previous to its adoption for the $\frac{1}{2500}$ scale maps, in 1855. This shows that zinc has been successfully used for a long time, not only at Southampton, but

elsewhere. It was used at Nottingham in the early days of lithography; and in 1870 it was practically almost as well known as printing from stone. Patents of machines before 1857 include the process of zincography coupled with lithography. Coming to more recent times, when Möller's patent (1883) was exploited by C. & E. Layton, zinc became common, and as one of the earliest workers upon patent coated zinc plates, I may record that the zinc plates of that day, whether coated or plain, were successfully manipulated to no small extent. Improvements have been made in varions directions, but even twenty-five years ago Dickes pointed out the use of silicates in treating zinc, to make a surface like stone and repellent of ink when damp.

Methods have been improved, but the principles have been but little altered during the whole time the metal has been in use. With aluminium it is not quite the same. The metal has only been known in a popular way for less than fifty years, and it was not actually introduced in the printing trade until Mullaly and Bullock's patent of September 8th, 1891. At that time it is easy to recall the deprecatory remarks of men "who had been using aluminium before that time," to use their own words, when trying to show that the patent was untenable. Such remarks however need carry no weight, for it was not so. It may be stated that experiments with an alloy of aluminium and zinc were conducted in 1891 in Berlin. When I visited every lithographic firm in Liverpool—and the whole West of England from Carlisle to Plymouth, as well as most of the Midland towns—in the summer and autumn of 1892, the only mention of any actual usage of aluminium was made by the late

Paul Richter, then at the Liverpool Printing & Stationery Company's house. It was then spoken of as quite a new introduction. And it may be readily inferred that it was due to Mullaly & Bullock's invention, as an account of this novelty had appeared in the printing trade journals, consequent upon the taking out of the British patent 15,238 in 1891. The progress of aluminium has all occurred since 1897 and its use even at the present day (1909) is comparatively restricted. About 1898 the Aluminium Litho-Plate Co., of Liverpool, were dealing in plates.

As to whether zinc or aluminium is to be preferred to stone from the workers' point of view, there are no two opinions. Stone is undoubtedly the best.

In dealing with plates versus stones, the advantages in many respects are very great. This was fully recognised in 1887, when the Litho-Plate Co. set out at length the following points of vantage :—

> "Work can be transferred to them with even sharper and clearer results than from stone.
>
> "There is no tendency for the work to spread, nor does it become weakened, remaining perfect after many thousands of impressions.
>
> "Work engraved can be printed in the press or machine.
>
> "Originals can be stored in small compass. Much time is saved in making off-sets, and artists can work on them more conveniently.
>
> "There is no risk of breakage, like stone.
>
> "Their portability is very advantageous; [as plates can be sent to and from any part of the country for drawing and printing at much less cost and risk].

"Photo-lithographers can transfer their work upon them.

"The treatment [of litho-plates] is nearly the same as stone.

"Their price is much less than stone.

"They can be re-coated at about the same cost as re-polishing [and may be used for several designs before re-coating]."

Add to this their adaptability for direct photography, and for half-tone and collotype transfers, to complete the list of what might be termed advantages.

From the economic aspect metal must be used if planography is to retain its position as a competitor of or aid to typography. The necessity for more expeditious production has been the impetus for the invention of rotary machines of such high standard as now exist. And it may be added that not a few of the houses which held but minor positions within the last eight years, have grown to respectable dimensions, and to take rank with large and old concerns, owing to their judicious use of rotary machines. Such progress in planographic printing has placed the craft in a still better position than ever it held, with a proportionately larger number of artisans employed, and with a ratio of unemployment which compares very favourably with any other skilled handicraft.

The fact that rotary machines exist, of enormous capacity of output, and that metals are so well understood that many artisans can manipulate them, it may be taken for granted that printing from metal (Metalography) is and will continue to be a very important part of the printing industry, and deserves to be dealt with in all its phases, as attempted in the following chapters.

To further draw distinction between the metals themselves as to which medium to adopt, it is necessary to always follow the course of least resistance. When aluminium was introduced in 1892, and more recently in 1898-9, many features were claimed for it, as advantages over stone, not to say zinc. It was then contended that its superiority to zinc was sufficiently clear, that it was to be pressed forward as the one substitute for stone. But printers did not see eye to eye with these contentions.

Efforts were made by that well-known investigator of zinc printing—Mr. G. H. Block—which resulted in the production of zinc plates of the best quality ever put upon the market. On the other hand the manipulation of aluminium was not so simple nor so certain as zinc. Aluminium therefore only obtained a slight hold of the trade, which has progressed gradually for the last ten years. But the impetus given to Metalography had its effect on the use of zinc, especially as zinc was so much cheaper, and, which is of far greater importance, the use of zinc had become so popular since 1885 that most craftsmen were accustomed to it in the plain or prepared form. There were many men in Great Britain well known to the writer who used zinc plates for all purposes with the greatest success, many of whom, again, preferred zinc plates to stone for certain purposes. It is noticeable, too, that O. C. Strecker, in his patents of 1900 and 1902, especially the latter, singles out zinc as the metal of his preference, and Mr. G. H. Block's patents from earlier dates dealt with zinc as the most suitable metal. Under such varying opinions experiments have been conducted for some years with tyros in Metalography, and the results of such experiments

prove conclusively that with equal instruction given upon zinc and aluminium, the results are equally as good from either metal.

One more consideration of Metalography is of such importance as to claim the attention of the whole trade. Machines for lithographic printing have been improved during the past thirty-eight years so rapidly that twenty-eight years ago—long before attention was given to letterpress machinery in the same direction—they were capable of producing any subject in seven to thirty printings with comparative accuracy of register. The rotary machines proper, which commenced with T. R. Johnston's machine of 1895, have always had accuracy of register as of paramount importance. So it may be taken that any rotary machine of to-day will print any number of colours with almost accurate register. This point places the rotary machine in a position that it is the handmaid or assistant of any letterpress printer who desires to combine the mechanical products of the letterpress machine with the soft transparent colourings of the lithographic printer. In other ways this combination of letterpress and lithographic printing can be utilized almost *ad infinitum*, to the benefit of the employer. So varied is the application that it would seem impossible for a letterpress printer or a lithographic printer to exist as a separate concern without its co-partner. The letterpress printer who has to print many subjects at one time fails to recognise the ease and cheapness with which lithography can be brought to his aid, whilst lithographic printers who aim for the accuracy and clearness of half-tone block work, fail to appreciate the true co-operation of the kindred craft.

With both machinery of the highest type, and methods of great perfection, the future of both letter-press and lithographic printing should have no drawbacks. The proper combination of both, coupled with a living interest in the trade, on the part of employers and employees alike, cannot fail to give a long and prosperous career to all engaged in the printing trades.

METALOGRAPHY.

CHAPTER I.

Lithographic Stone.

THE basis of surface (planographic) printing is undeniably chemical. There is scarcely any better proof of this than the processes of printing from the surfaces of zinc and aluminium and stone. It becomes the more apparent when any attempt is made to print from glass, wood, or other metal surface. Although there are some points in common, mainly due to the same kind of transfer ink being used, yet the general treatment of stone, zinc and aluminium has marked differences, due to the variation in the chemical action or affinities of the material used. To make this clearer; the composition of lithographic stone may be roughly taken as calcium carbonate (a body, the principal constituent of chalk, marble, sea-shells, coral, and other rocks in the earth's crust) with about a 3 per cent. admixture of magnesium carbonate and traces of iron salts, with silicates of alumina, &c., sodium and potassium chlorides. So small a quantity of magnesium carbonate may seem not worth notice: but when a stone weighing rather more than 1 cwt. (say 130 lbs.) is analysed, it will be found to contain 4 lbs. of magnesium carbonate, or a quantity sufficient to heap up in a thick powdery layer all over the stone. It may be the presence of the magnesium carbonate, or the physical texture of the stone resulting from the peculiar conditions under which it was formed at the bottom of some inland sea or estuary, that makes the appreciable difference between lithographic stone (or "slate") and the other forms of calcium carbonate, such as marble, which fits it for surface printing. As compared with zinc and aluminium it is a complex compound

capable of various chemical actions. It may be used for the manufacture of carbon dioxide (CO_2) for the preparation of aërated waters. It may be used as the means of obtaining the little required metal, calcium (Ca). This metal is a strongly alkaline, silver-white substance, similar in properties to potassium, but harder. Potassium (K) metal when thrown on water immediately becomes hot and bursts into flame, as it unites with hydrogen (H) and oxygen (O) in the water to form caustic potash or potassium hydrate (KOH), a material so caustic that it will partially take the skin off the hands. Calcium is not quite so active, as it decomposes water much less vigorously, even than sodium.

Calcium is allied to barium (Ba) and strontium (Sr), these three being the group of alkaline earth metals. From lithographic stone can be prepared quicklime, or calcium oxide (CaO) which unites with water to form calcium hydrate [$Ca(OH)_2$], a substance which is a powerful alkali, almost as strong as caustic soda (NaOH) and potash (KOH). And amongst the many compounds of calcium formed by treatment of carbonates and chlorides of calcium with acids may be mentioned gypsum, alabaster, sulphide (luminous paint), phosphate (in human bones), and sulphate and bi-carbonate giving hardness to water. It is largely due to its complex character and it being a basic rock that lithographic stone is suitable for its work in surface printing. A compound such as calcium carbonate and magnesium carbonate, as naturally found in lithographic stone, is more easily attacked by chemical agents than its outward appearance would seem to convey. It is a body rather susceptible to change when treated with substances having a chemical affinity for its constituents. Thus, being an alkaline earth, when treated with acids it readily forms salts and loses its gaseous constituent, carbon dioxide (CO_2). This is so much the case that even some other compounds, which are themselves only loosely combined, will break up when placed on lithographic stone, the acid constituent combining with the calcium of the stone, and the basic constituents in some cases combining with the gaseous part (CO_2). In all such interactions there are considerable divergences in the vigour of the chemical actions, and in the stability of the products formed. This may be illustrated by the action of a few acids on stone. When the stone is treated with oxalic acid ($C_2H_2O_4$) the

immediate action is almost imperceptible, but the salt formed, viz., oxalate of lime, or calcium oxalate (CaC_2O_4) remains on the surface of the stone, strongly adherent, forming a glaze which can be turned to good uses in the course of printing. In using acetic acid ($C_2H_4O_2$) an acetate of calcium [$Ca(C_2H_3O_2)_2$] is formed: this substance being very soluble in water, and at the same time disposed to adhere, it will often form a thin film on the stone, which proves disastrous in subsequent operations. With sulphuric acid (H_2SO_4), calcium sulphate ($CaSO_4$) is formed, a fine dusty compound which may or may not be easily washed off, whilst the acid's action seems to give, more or less permanently, a crumbling action in the surface of the stone. With hydrochloric acid (HCl) the stone is rapidly acted upon and converted into calcium chloride ($CaCl_2$), which is soluble in water, giving the same results and the same dangers as when acetic acid is used. The action of citric acid ($C_6H_8O_7$) produces calcium citrate [$Ca_3(C_6H_5O_7)_2$], a powdery substance which has little or no tendency to cling to the stone, and is readily washed off. With phosphoric acid (H_3PO_4) the phosphate of lime [$Ca_3(PO_4)_2$] is formed, which is similar in behaviour to citrate of calcium. Tartaric acid ($C_4H_6O_6$) in forming calcium tartrate ($CaC_4H_4O_6$) yields a body again similar to citrate of lime; but when nitric acid (HNO_3) is used the action is very vigorous, possibly oxidising the grease or scum, and converting the superficial layer of the stone into calcium and magnesium nitrates, which are very soluble in water and easily washed off with water without any fear of leaving either a crystallizable or adherent compound. Thus in summarising it will be seen that nitric, hydrochloric and sulphuric acids act vigorously; citric, phosphoric and tartaric acids act slowly; acetic acid, still more slowly; and oxalic acid, almost imperceptibly; that hydrochloric and acetic acids form soluble compounds and the others form insoluble compounds; that oxalic acid forms an adherent compound; acetic and, to some extent, sulphuric acids form compounds which are very difficult to remove by washing; whilst citric, tartaric, phosphoric and nitric acids form non-adherent compounds.

In further considering actions upon stone exerted by compounds, there are some four or more materials in common use affording illustrations of how one compound will break up in the presence of another and suffer an interchange of

constituents. When gum arabic solution is put on lithographic stone, especially when used after an etch, there is reason to believe that the potassium (K) of the gum unites with the carbon dioxide (CO_2) of the stone, forming potassium carbonate (K_2CO_3). This action liberates some arabic acid from the gum, which, in turn, may act on the calcium carbonate of the stone and form therewith calcium arabinate, or a modified gum, actually in the stone's surface. In treating stone with bi-carbonate of soda ($NaHCO_3$) it is again highly probable that the bi-carbonate of soda forms calcium and magnesium carbonates, both soluble in water, causing a little local disturbance of the stone's surface; or it may be that the "soda" emulsifies any grease on the stone, or even gum on the stone, so that a mere wash of water leaves the surface fresh and clean. In the same way whitening ($CaCO_3$) applied to a stone will possibly, by rapid interaction of the potassium arabinate, give a fresh surface even better than the soda. When alum [Al_2 $(SO_4)_3$ K_2SO_4 $24H_2O$] is applied to lithographic stone, an action proceeds very similar to that of the less vigorous acids, owing to the presence of a little free sulphuric acid; but it has other undesirable results which should preclude its use from most lithographic printing processes. Solution of aluminium sulphate has been used satisfactorily, in the same way as "Liasine" is used, on stone.

In dealing with the chemical actions of stone, the matters so far discussed have been acids and compounds of a basic and acid character. But there is another series of re-agents known as alkalis whose action has not been described. The alkalis are best represented by the bodies caustic soda (NaOH), caustic potash (KOH) and ammonia (an aqueous solution of NH_3). These bodies have a tendency to decompose fats, because fats contain fatty acids with which an alkali will form a compound—frequently a form of soap. When alkaline solutions are placed on stone, little or no action takes place. But, as already stated, alkalis act on fats, or fats on alkalis; so when transfer ink is placed on stone, the free fatty acid present will attack the calcium and magnesium carbonates ($CaCO_3$ and $MgCO_3$) of the stone and form, not a soap in the ordinary acceptance of the term, but a permanent calcium or magnesium soap. Upon this interaction is based the whole art craft of printing from the lithographic stone.

The object of treating this matter at such length is to show how different re-agents act upon the lithographic stone, and to finally show the chemical basis of the power to use stone for printing. In dealing with the metals much of this detail may be omitted, provided that the illustrations of the treatment of stone are always kept well in view.

CHAPTER II.

The Metals. I.—Aluminium.

THE general character of the metals aluminium and zinc present a distinct contrast to lithographic stone. Both of them may be used in thin sheets or plates, providing proper means of attachment or mounting are available. They are, so far as chemical knowledge at present exists, practically pure metals, and are actual elements. They are the metals extracted from their earthy compounds, just as metallic calcium may be extracted from lithographic stone. Being elements there are much fewer possibilities of secondary chemical actions, as is the case with a compound such as lithographic stone. And, further, the chemical affinities of an elementary metal vary considerably with the re-agents used for stone, whilst some re-agents which act upon stone feebly, or not at all, have quite another action on these metals.

Aluminium as a metal has not been known as long as lithographic stone, for it was only in 1827 that it was first discovered. Its early method of extraction was so expensive as to preclude its general use, and although electrical methods of procuring it were patented in 1885, yet it was not until the Héroult-Hall method was introduced that any great advances were made in its common application. In 1890 the world's output of aluminium was 40 tons, and the price was 9/6 per lb. In 1900 the output was nearly 6,000 tons, and the price had fallen to 1/4 per lb. In 1907 one authority estimated the annual output at over 15,000 tons, of which Canada produced about 3,000 tons, and foreshadowed a rise in price. These two dates mark epochs in the use of aluminium as a printing surface. 1890 just preceded Bullock and Mullaley's patents of 1891, when aluminium was first well brought to notice for printing purposes; and 1900 was just subsequent to the methods of Strecker and Christian Scholtz, which undoubtedly made aluminium a much more satisfactory article for surface printing; and since that time there has been a regular progress in its adoption. Aluminium

(Al) is very light, having a specific gravity of 2·7, whilst zinc is 7·1. Its atomic weight is 27·1, as compared with zinc at 65·4. As further illustrations of its weight it may be stated that the atomic weight of gold is 197 and of lead 206·9. Amongst its various properties may be mentioned that it melts at 654° C., and at 100° to 150° C. it is very malleable. It is frequently impure from the presence of iron, silicon, carbon, copper, zinc and lead. When pure it is slightly affected by the air, and at high temperature it readily forms the oxide (Al_2O_3). It is a greyish white metal, not very brittle, in thin sheets; without taste or odour; and capable of taking a fine polish. As some indication of its hardness and other qualities it may be mentioned that aluminium oxide occurs naturally as corundum; and with ferric oxide as emery. The same oxide, when coloured with chromium and cobalt salts, is found as ruby and sapphire.

Aluminium hydroxide [$Al_2(OH)_6$] is used for precipitating "lakes" upon, and is used as a mordant in dyeing processes. And aluminium sulphate [$Al_2(SO_4)_3$ $18H_2O$] is a white powder used in paper-making. One other common compound is the double salt of aluminium with either potassium, sodium, chromium, or ammonia, and sulphuric acid, known respectively as alum, soda alum, chrome alum or ammonium alum. Aluminium is of world-wide distribution as it is the common silicate of clay, as well as occurring in gems, in cryolite, bauxite, diaspore, gibbsite, mica, zeolite, felspars and china clay, and constituting little less than one-twelfth of the earth's crust in compound forms.

Touching those features of aluminium which appeal directly to the printer there are its physical characters which have frequently caused some doubt as to its suitability. Although often considered wanting in tenacity, it will withstand 12 to 15 tons to the square inch, and in tension its strength lies numerically between that of best steel and iron wires. It is not surprising, therefore, that at 40° C. (104° F.) its coefficient of expansion is only ·002313 for every rise of one degree in temperature. If a sheet of aluminium were 1,000 inches long, a rise of temperature of 1° C. would increase its length 2 inches, or, put in another way, it increases only $\frac{1}{500}$th of its length for every rise of 1° C. The stretching of a sheet of aluminium when being run in the machine is so infinitesimal that it need not be considered. For use in printing, aluminium has a small

percentage of tin added. Most metals oxidise in the air, if only slightly, and aluminium is no exception. Most metals combine with sulphur in the air, forming usually blackened sulphides, as bronze for instance, but aluminium does not. A peculiar feature of aluminium, however, is that if sprinkled with drops of water and the water allowed to dry, the spots so formed will ultimately take ink. And, although aluminium is not generally considered to oxidise in the air, yet, if it be kept even well wrapped up, the surface becomes affected, or becomes stale, with a thin transparent film of oxide, and is unfit to draw or transfer upon until scoured with a fine gritty dust, such as pumice powder. The oxidation of aluminium in air is the difficulty which has been met with in soldering aluminium, and is well known to metal plate workers.

In the actual treatment of aluminium its chemical characteristics are of the utmost importance, because it differs so much from lithographic stone.

Aluminium treated with nitric acid is not affected more than very minutely if allowed to act for twelve months. The action then, most probably, is only the decomposition of minute particles of impurity in the metal, and not an action on the metal itself. This difference from lithographic stone at once causes a considerable alteration from common usage, and to serve the purposes of nitric acid on stone another re-agent must be used.

Aluminium treated with hydrochloric acid (HCl) is immediately attacked vigorously, and a small slip of thin aluminium in a test tube is entirely dissolved in two minutes.

Aluminium treated with powdered phosphoric acid (H_3PO_4), and water added, evolves heat, gives every opportunity for chemical action, yet the aluminium is apparently unattacked.

Aluminium with the organic acids, acetic ($C_2H_4O_2$), citric ($C_6H_8O_7$) and oxalic ($C_2H_2O_4$) tested separately shows no action, but on the addition of common salt (NaCl) a slight decomposition occurs.

Aluminium with concentrated sulphuric acid (H_2SO_4) apparently shows no action. But upon adding water heat is evolved, and a strong decomposition is set up.

Aluminium with caustic potash (KOH) immediately commences a steady decomposition.

Aluminium with caustic soda (NaOH) acts exactly the same as with caustic potash.

These are the results of experiments performed in a way that anyone can follow, and with the results stated in ordinary terms, rather than in chemical phraseology. Aluminium, when treated for a little time with caustic soda, becomes fibrous and can be pulled apart in rough threads.

To appreciate to the full the nature of aluminium the chemical investigation must, however, be carried to its furthest possible extent. Its compounds and its occurrence in nature must be studied, and their re-actions must be taken into full account.

Aluminium is unaffected by hot or cold water, but under pressure with steam a slight decomposition may occur. Sulphuretted hydrogen and a few other sulphides fail to attack it. Most metals are readily precipitated by both sulphuretted hydrogen (H_2S) and ammonium sulphide. In fact, it is only upon fusing aluminium with sulphur (S) or oxygen (O) that the compounds are formed. Aluminium oxide (Al_2O_3) may be produced by the fusion of aluminium in the air, or by fusing (igniting) ammonia alum [$Al_2(SO_4)_3(NH_4)_2SO_4\ 24\ H_2O$] or aluminium sulphate [$Al_2(SO_4)_3\ 18\ H_2O$] to white heat. This oxide in its amorphous state, after being heated, is slightly attacked by sulphuric acid (H_2SO_4) and hydrochloric acid (HCl). It may also be obtained in a crystalline form by heating to a high temperature a mixture of aluminium fluoride (Al_2F_6) and boron trioxide (B_2O_3). In the crystalline form it is similar to the gems, rubies and sapphires. It is nearly as hard as diamond, and unattacked by any acids. Aluminium oxide may act as a feeble acidic oxide under certain conditions; but aluminium forms compounds known as hydrates (hydroxides), two of which bring it into a condition where it can be dealt with more on the lines of other metals. The aluminium dihydrate ($Al_2O_3\ 2\ H_2O$) is apparently a feeble compound of aluminium oxide with water. This hydrate when freshly precipitated is easily soluble in acids, and even forms salts with acetic acid ($C_2H_4O_2$). But the aluminium trihydrate ($Al_2O_3\ 3\ H_2O$) is a soft, bulky, friable mass which, when freshly prepared, is readily acted upon by acids, potash and soda. It is these hydrates which make it possible to deposit the aluminium oxide

upon fabrics, in combination with colouring matters, as in dyeing.

As a direct comparison with zinc, it may be pointed out that whilst solutions of caustic potash (KOH) or caustic soda (NaOH) will produce zinc hydrate [$Zn(HO)_2$] from zinc sulphate ($ZnSO_4$), aluminium hydrate treated with caustic potash forms potassium aluminate ($Al_2K_2O_4$); and that similar aluminates occur naturally, as spinel, the magnesium aluminate (Al_2MgO_4), and galinite, the zinc aluminate (Al_2ZnO_4). Such characteristics seem to place aluminium in a different aspect. They apparently give it the property of an acid capable of forming salts with a base. More especially may this be inferred as it forms a salt of zinc.

Alums are double salts, consisting of aluminium sulphate [$Al_2(SO_4)_3$] and the sulphates of sodium (Na_2SO_4), potash (K_2SO_4), or ammonium [$(NH_4)_2SO_4$], in each case with 24 molecules of water ($24\,H_2O$), which would seem to indicate that whilst the sodium, or potassium, or ammonium sulphate may be considered as the basic compound, the aluminium sulphate may be considered as the acid compound.

This discussion of aluminium and its compounds, and in other forms where, apparently, it is of no importance to the printer, has been entered upon to determine, as far as possible, the true light in which aluminium must be viewed as a chemical agent. To still further assist in this determination, it may be added that aluminium unites with the non-metallic element bromine (Br) to form aluminium bromide (Al_2Br_6); also with the non-metallic element fluorine (F) to form aluminium fluoride (Al_2F_6); whilst a double salt of aluminium and fluorine with sodium (Na) occurs in Greenland as cryolite ($6\,NaF\ Al_2F_6$). To these non-metallic attachments may be added the large number of aluminium silicates, including kaolin, porcelain or china clay ($Al_2O_3\ 2\,SiO_2\ 2\,H_2O$), staurolite ($4\,Al_2O_3\ SiO_2$), andalusite and kyanite ($Al_2O_3\ SiO_2$), and allophane ($Al_2O_3\ SiO_2\ 6\,H_2O$).

It has been shown that aluminium is not, like many metals, readily attacked by most acids, yet it is easily acted on by alkalis; that aluminium oxide is a feeble acid; that aluminium forms compounds with alkalis, non-metals, and some metals (magnesium and zinc); that alums have an acid reaction. It may, therefore, be regarded as standing in an intermediate position between elements of acid and alkaline character, and bordering very closely upon the non-metallic, acid-forming state.

CHAPTER III.

II.—Zinc.

ZINC (Zn) is nearly three times heavier than aluminium, having a specific gravity of 7·1. Its atomic weight is 65·4. It melts at 419° C., a temperature which is much more easily reached when using bunsen burners for heating purposes, than is generally supposed. Pewter, which is an alloy of tin, antimony and a small amount of copper, melts at a lower temperature. This is the metal used for music engraving. Zinc boils at 925° C. and then volatilizes. If zinc be heated in air, in a bunsen flame, it burns with a greenish flame, forming the white flaky substance, zinc oxide, or permanent Chinese white (ZnO).

Zinc or spelter is a bluish-white crystalline metal, of a brittle character, but at temperatures between about 120° C. and under 200° C. it becomes malleable, and, after being made malleable, it retains that character when cold.

It is prepared from blende (zinc sulphide, ZnS) and calamine (zinc carbonate, $ZnCO_3$) by roasting in air, then calcining with coal to liberate the metal. It is generally associated with lead in its natural state, but zinc volatilizes, and can be driven off from impurities and distilled practically pure. As zinc is scarcely affected by the air or weather, its use in galvanising, or plating iron is very extensive. Zinc, too, forms a constituent of brass and other alloys, and is largely used as the negative pole in galvanic batteries.

Zinc treated with sulphuric acid (H_2SO_4) forms zinc sulphate or white vitriol ($ZnSO_4$) and liberates hydrogen gas (H). It is used as a drier in pigments; its properties being taken advantage of as an eye lotion, and for sores and ulcers. It is also used in calico printing as a mordant. With hydrochloric acid (HCl) it makes zinc chloride ($ZnCl_2$), used in tinning and soldering as a flux. This compound is also known as zinc butter. It has caustic properties, acting as an irritant poison; but it is also used as an antiseptic, under the name of Burnett's

disinfecting fluid. Its property is that of withdrawing the elements of water from organic matter; and when used in the solid form is a caustic.

The native ores containing zinc are found in large quantities in Great Britain, Silesia, around Aix-la-Chapelle (Aachen), Belgium, France and Spain.

Zinc, as a chemical element, is practically pure. The purest product is not affected by acids to the same extent as less pure forms. It is, however, attacked by most acids, but scarcely affected by alkalies. Some acids have a much greater affinity for it than others. Thus, with lithographic stone, it may be said that nitric (HNO_3) and hydrochloric (HCl) acids have the greatest action; so with zinc it may be equally accepted that sulphuric (H_2SO_4) and hydrochloric (HCl) acids have a particularly vigorous action. In treating of zinc it should always be remembered that after extraction from the natural ore it has ultimately to be prepared in sheets which undergo much rolling. As a natural product, dealt with in the most expeditious manner to insure cheapness, there can be little guarantee of its uniformity. Even though it be pure and hard in parts, there are certain to be appreciable areas of softer metal. Such areas of softness, arising from unequal annealing in manufacture, are the areas first attacked by acids. This defect of zinc led to the practice of "amalgamating" zinc plates in galvanic batteries by coating them with mercury. In lithography such a method is not available, and printers have to rely upon manufacturers to produce plates as homogenous as recent scientific discoveries will permit. In one feature alone zinc is better than aluminium, namely, in its very low coefficient of expansion. Whilst aluminium expands $\frac{1}{500}$th of its length for every 1° C. rise in temperature, zinc only expands about $\frac{1}{3000}$th of its length for a similar rise; its coefficient of expansion being ·000294.

In pursuing the study of zinc closely into its chemical reactions, as they affect the lithographic printer, experiments have been made to find to what extent re-agents attack it. The results of such experiments are briefly as follows:—

Zinc treated with nitric acid (HNO_3) is rapidly attacked by dilute solution and wholly dissolved.

Zinc treated with hydrochloric acid (HCl) is readily attacked by dilute solution; wholly dissolved; leaving a

comparatively large amount of dark, dirty residue of lead, originally an impurity in the zinc.

Zinc treated with sulphuric acid (H_2SO_4) is attacked gently by dilute solution; wholly dissolved; leaving a little dark powdery residue of lead.

Zinc treated with phosphoric acid (H_3PO_4) is attacked moderately by concentrated solution; partially dissolved; and a mass of flaky dark compound is formed in the solution.

Zinc treated with acetic acid ($C_2H_4O_2$) in concentrated solution is not attacked. When the solution is dilute, a feeble decomposition is set up on the clean-cut, raw edges.

Zinc treated with citric acid ($C_6H_8O_7$) in strong solution, sets up a feeble decomposition in the course of some time. No immediate action takes place.

Zinc treated with common salt (NaCl) in strong solution ultimately sets up a feeble decomposition.

Zinc treated with oxalic acid ($C_2H_2O_4$) in strong or dilute solution apparently gives no action.

Zinc treated with alum [$Al_2(SO_4)_2$ K_2SO_4 $24H_2O$], or cold solutions of potash, potassium hydrate, caustic potash (KOH) or caustic soda (NaOH) or ammonia (NH_4OH), is apparently unattacked.

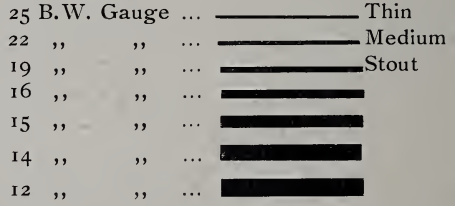
In stating these results no attempt has been made to enter into what does occur and what compounds are formed from the chemist's point of view, but simply the apparent results visible to any printer. It may easily be shown that zinc is slowly dissolved in hot solutions of caustic soda (NaOH) and caustic potash (KOH). And to show the complexity of one of these reactions it may be stated that when zinc is treated with nitric acid the following compounds and gases are formed, viz.: zinc nitrate, zinc nitrite, ammonium nitrate, ammonium nitrite, nitrous oxide, nitric oxide, nitrogen, &c.

Although it may be said that zinc withstands the effects of the air and weather, yet it is much more probable that the basic carbonate formed by such exposure makes an artificial surface protection.

Zinc is not attacked or acted on by the mineral lubricating oils, but is slightly acted upon by common animal oils. Metallic zinc will precipitate from their solutions many other metals,

e.g., arsenic, cadmium, copper, lead. In attempting to arrive at conclusions as to the use of zinc in printing, it is necessary to deal with some of its compounds. Zinc oxide (ZnO)—Chinese white—is insoluble in water, but dissolves readily in aqueous solutions of acids forming the various zinc salts (compounds). It should be inferred, therefore, that zinc oxide and zinc itself are of a basic character. Lithographic stone has already been shown to be a compound of a basic character; so that, roughly, a chemical similarity appears to exist between zinc and stone. When zinc sulphate is treated with the alkalis, caustic soda or potash or ammonia, a hydroxide of zinc [$Zn(HO)_2$] is formed, resembling in chemical formula the three alkalis above, represented respectively by the formulæ NaOH, KOH and NH_4OH. Further, in the principal alums, where aluminium, iron, chromium or manganese, take part with sodium, potassium or ammonium in the formation of the salt, zinc does not appear. Yet, in the pseudo-alums, one exists in which the iron compound seems to have the acid function, and the zinc compound takes the basic, thus :—$ZnSO_4\ Fe_2(SO_4)_3\ 24H_2O$.

Zinc, as used in printing, is rolled into moderately thin plates, varying from 19 to 29, measured by the Birmingham Wire Gauge, 25, 22 and 19 being the usual stock gauges according to the superficial dimensions of the plate. Very thin metal up to 36 B.W. Gauge is being used for off-set rotary machines. The makers of the Parker printing plates have now placed upon the market zinc plates of 33 B.W.G., and no doubt other makers will soon follow the same example.



Zinc plates can be conveniently cut in a bookbinder's card-cutting machine, or by a suitable saw. The brittleness of zinc is, to some extent, a disadvantage in bending it on the bedplate, and frequently it breaks, even though only at the surface. But, as it is so little affected in ordinary air,

it has a distinct advantage over aluminium in general workshop usage. The edges of the zinc which are to be placed in the clamps either of flat-bed or rotary machines should be folded over about quarter of an inch. Zinc may be used in its raw state equally as well as any of the prepared zinc plates. There is little doubt that since Möller's patent zinc plates in 1885, that all the variations in the surfacing and preparing of zinc have been well tried. Some have held favour for a much longer period than others, such as the Hull zinc plates; and, as an outcome of their manufacture may be mentioned G. H. Block's zinc plates, which are, undoubtedly, the best form of prepared zinc plates printers have used. These latter are prepared in such a way that they may be considered as little different to raw zinc; and in treating of zincography the same remarks will apply to them as for raw zinc. The advantage of these prepared plates is the care exercised in their preparation and the comparative whiteness of the surface. It is unnecessary to state that neither artist nor printer prefers a zinc plate to a stone, whose natural characteristics are such as to place it always in the first place for drawing upon and printing from.

Zinc has been used polished, but its inability to retain moisture evenly on the surface makes it very difficult to work. It is recommended always to have it grained. The graining is a mechanical process, and may be done by sandblast, by hand as for stone, or by the graining machine (Huber's make). The sandblast was very effective when carried out in Tilghman's machine. But, under general conditions, the sandblast does not give that peculiar uniformity and character produced by hand or machine. The sandblast works upon zinc, as it does upon glass, by actually cutting pieces out of the plate. The general surface of the plate retains a comparative evenness, whilst the "grain" consists of a number of little indents resembling the curious borings of the paper by the bookworm, and all of them the same depth. On the other hand, the zinc grained in the machine seems to present a crumbly mountainous aspect with considerable variations in depth, so well suited to the production of fine crayon drawings. The grain, in both methods, serves the purpose of retaining an even film of moisture on the plate, thus rendering it easier to print from than when polished.

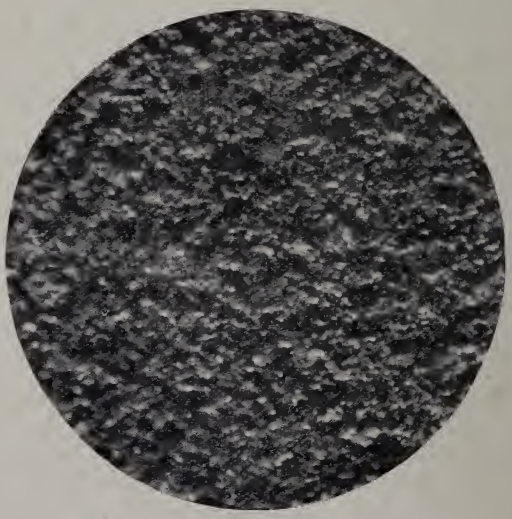
It has been stated that when zinc is calcined it is more

"porous," and that if a special crystalline deposit be then made in the surface of the plate, it gives a fine bright surface equal to aluminium. Such treatment is said to prevent oxidation, and to greatly strengthen the affinity of transfer ink.

It has recently been stated that an alloy of one part zinc and two parts aluminium makes a plate of similar printing qualities to zinc and aluminium. It is known as "Alzene," and is supposed not to oxidize.

In 1891, Mr. G. E. Heyl, of Berlin, and Mr. G. H. Block, applied for a patent for an alloy of aluminium and zinc. But they found that the metals did not combine in any proportion, and that the various acids, etc., acted differently on the two metals.

Zincography, like lithography, means writing or engraving upon the substance. As early as 1805 H. W. Eberhard of Magdeburg used zinc as a means of etching blocks. It was not long after that date that zinc was used for surface printing as a substitute for stone.



SANDBLAST FINE GRAINED ZINC, MAGNIFIED 60 TIMES.

CHAPTER IV.

Printing from the Metals.

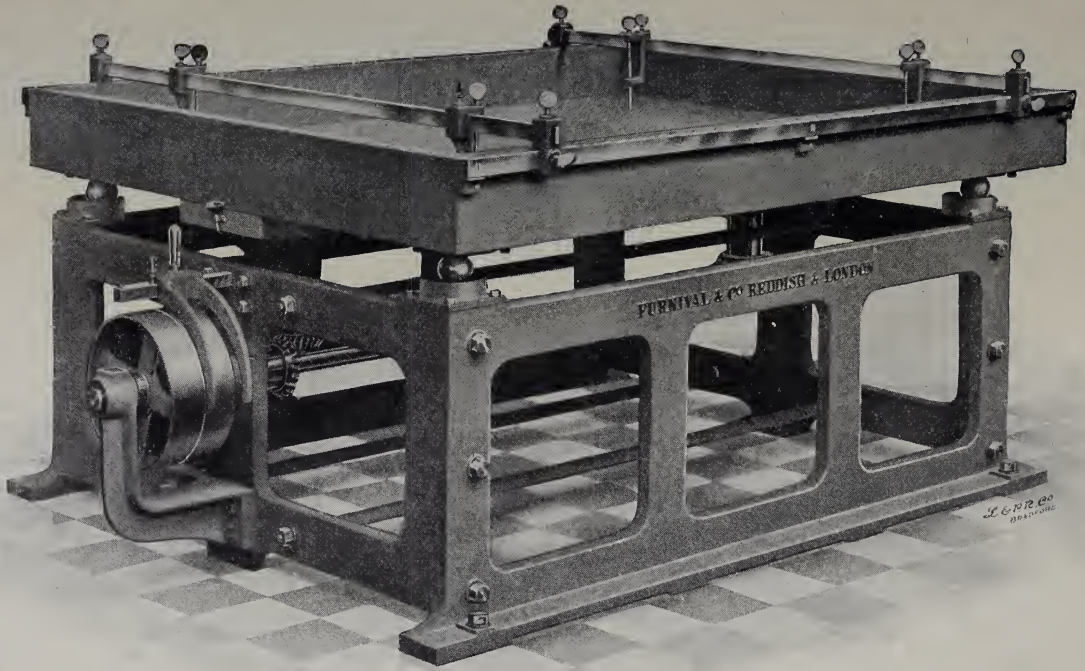
At the outset it may be as well to lay down the important stipulation, that if anyone is to succeed in printing from the metals it is imperative that all ideas of printing from stone must be set aside. The metals must each be approached separately as a new or foreign surface. It is not intended by this to say that a printer's knowledge of the use of a roller, gum arabic, turpentine, transfer paper, the press and the machine is not to be applied to printing from metals. On the other hand such knowledge is invaluable, and must be brought into active assistance. But as soon as any re-agent has to be applied which exerts any chemical influence, then the difference between stone and each of the metals becomes apparent. The first three chapters of this work have purposely been devoted to the chemical aspect of the metals with a view of placing in the hands of the printer the reasons for all that is done, and to stimulate the workers upon metal to enquire further into the possibilities of printing from it.

CHAPTER V.

Grinding and Graining Plates.

In order that it may be dealt with systematically, this subject will be taken in sections. Whether using zinc or aluminium the plate must be grained. Thirty years ago it was understood that for transfers the zinc could be polished; but experience at that time was sufficiently negative to warrant the statement that both metals must be grained. The mechanical method of placing the plate in the bottom of a large flat trough or tray, sprinkling with very fine sand, ground glass, or pumice powder, then covering the entire surface with heavy "marbles"—usually little glass spheres—and fine sand, if a fine grain be required, or lighter wooden spheres with pumice powder if a coarser or flatter grain be required, or porcelain "marbles" if a coarse deep grain be required, and setting the tray in motion at about 150 revolutions per minute, has every possible recommendation.

In putting in the marbles it is best to cover the plate thickly with them, then add thirty or forty more to lie on the others at first, but ultimately to fall into spaces as they occur and complete the solidity and uniformity of the graining mechanism. After graining, the balls and the trough must be thoroughly washed out. This method has been tried so long—some eight years—that it has received a well-deserved appreciation. It is only in houses where graining is seldom required that the hand method is likely to prevail. In the hand method, referring again to thirty or forty years ago, a muller of stone was used to grain the metal, after it had been covered with sand, ground glass or pumice powder, and sprinkled with water. For some unknown reason it was replaced by a zinc muller. It may be that the stone used had been too large and did not go into the depressions of the plate; it may be that a smaller stone muller, which would dip into the hollows, was too light in weight and too small to handle over a large surface. Still, the zinc muller became recognized as the more suitable, and, perhaps, the



Aluminium and Zinc Plate Graining Machine. 1900.

most suitable form it took was that of bending a piece of zinc over a large cork. In some Government offices, however, the muller was a solid zinc one. It is of little avail to argue that zinc is more suitable than stone as a muller, because it is zinc; for, at the present time, the most effective graining is done by small, light glass or wooden balls, or large porcelain "marbles."

In manipulating the graining machine, whether manipulated by hand or driven by power, the same care is necessary as in graining stone. The sand must not be allowed to work down to a slime before it is renewed, or a flat grain will be the result.

To suit fine and coarse work, plates should be grained in several degrees of coarseness, from a very fine matt surface to an open, crumbly, rough grain.

The graining already described covers that part of the preparation which must be given to all aluminium or zinc plates. There are, however, other preparatory methods necessary prior to placing the aluminium or zinc in the grainer.

ALUMINIUM.

If new aluminium be used it must be placed in a bath of one-third nitric acid and two-thirds water. This bath can be kept, and will retain its necessary activity for some six months. It can be refreshed by adding more nitric acid; and if it become dirty or dusty, some sulphuric acid should be added and the scum taken off.

After a plate has been in the bath for six hours during warm weather or double that time in cold weather, it must be taken out, well rinsed under a good flow of water, and it can and should be roughly ground with pumice powder and a felt rubber. In operating upon plates, they must always be supported on large flat surfaces. It is well not to let the plates in the bath touch one another; nor to take more than one at a time from the bath, as standing aside damp does them no good.

In treating old plates with work on, the work must be cleaned off with turpentine, or petroleum with pumice powder and a felt pad, followed with a wash of benzine, then placed in the nitric acid bath, for the same time as new plates. The plates should come from the bath with a fine, soft, white appearance. Alum in the proportion of ½-lb. to each gallon of water may be added to this bath.

Instead of immersing the plate for so many hours in the

nitric acid, alum and water bath, the plate may be cleared from old work by using the following solution :—

Nitric acid	6
Hydrofluosilicic acid ($H_2S_2F_6$)	10
Clean or distilled water ...	84

and rubbing the plate well with pumice powder and felt pad with this solution on it. The plate must be well rinsed and re-grained. The graining of such a plate should take about forty-five minutes. After graining the plate must be well rinsed with a strong spray to clear out any powder, and dried quickly with an absolutely clean sponge, or clean, boiled, linen cloth, then dried rapidly by a fire.

The graining of aluminium has been the subject of various treatment. It was discovered at an early date that drawings upon aluminium did not seem to get hold of the metal, as on stone and zinc. There seemed to be a lack of chemical affinity. The same trouble exists at present, for, if the drawing crayon should be too hard, or too "long," owing to too much shellac in its composition, or to the want of proper burning to "shorten" the wax, it appears to catch on the grain and break off in isolated particles, which give the appearance of a good half-tone or three-quarter tint, yet in reality these particles only adhere at one end, and when etched and rolled up they are bodily removed, leaving only their point of attachment as the remains of their effect as a printing surface. There is little doubt that the best medium yet remains to be discovered for drawing upon aluminium. In the efforts already made to secure the proper chemical contact of the drawing material and the plate, mechanical, rather than chemical, methods have been adopted. The treatment which apparently received much favour, and was, undoubtedly, the method which gave printing from aluminium the greatest impetus, was that of rolling the plates after graining so as to produce a burr or somewhat flattened or mushroom top on the grain, introduced by Herr Christian Scholtz in 1897. By this means, possibly, the drawing crayon was held in position until the etch had its effect, and chemically fastened the grease to the plate.

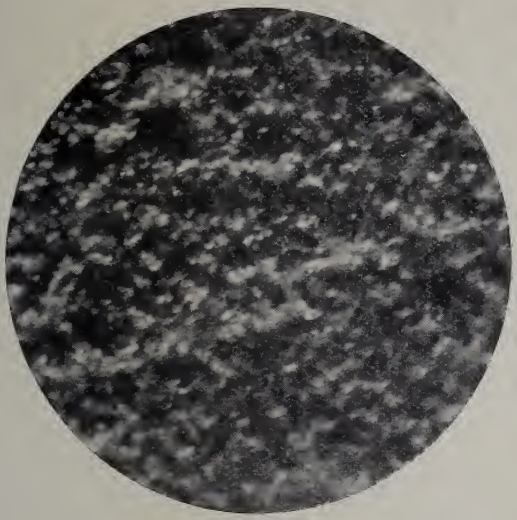
After a satisfactory grain has been produced the plate must be well rinsed with a flow of water; dipped in the nitric acid bath; well rinsed again and dried quickly, preferably in front

of a fire. It is then ready for drawing or transferring upon. It has already been stated that plates which are stored away, although well wrapped up, suffer a form of surface deterioration. It is slight oxidation and work will not go down on the plate satisfactorily. To obviate this, it is essential that every plate used by the printer must be freshened by scouring the surface with pumice powder and a felt rubber before any work is put on. It is of no avail to think that every new plate purchased has been newly prepared, and it is safer to treat all alike. When the plates are actually re-prepared in the house, and are used at once, such a precaution is unnecessary.

ZINC.

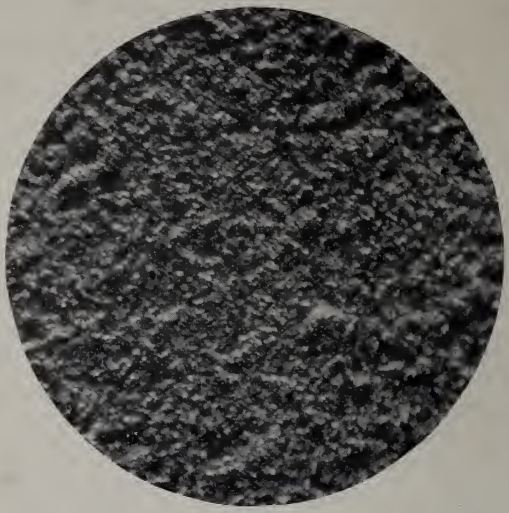
In the graining of zinc plates the nitric acid bath treatment is unnecessary. In the first place, if new polished or raw zinc plates are purchased, they should be well rolled through a press, placing pads of felt over any undulations to press them flat. Little dents in the plate may be hammered out with copperplate engravers' hammers, &c. Having obtained a good flat plate it should be well washed over with caustic soda solution. The plates may be grained after a good rinse, by hand or machine, and immediately rinsed under a flow of water, preferably hot, then dried quickly before a fire. If grained by hand, use sand sifted through a 150 or 160 sieve. Although zinc does not oxidize in air or damp, yet the moisture on the surface is a suitable vehicle and agent through which the carbon dioxide in the air may act. This acid gas converts the surface into zinc carbonate, and the carbonate effectually covers or plates the zinc, forming an impervious layer. Zinc kept absolutely dry is seldom affected in this way. The face of the plate with the work on must be kept thoroughly dry, and covered evenly with good gum and dried quickly, to prevent the action of the carbon dioxide of the air.

To re-prepare zinc plates which have had work upon them, the work is removed by washing with turpentine, followed by a wash with caustic soda—caustic soda, 1 lb.; water, 1½ gallons. The caustic soda neutralizes the fatty compound of the ink with the zinc. A plate so treated is to all intents and purposes clean. But it should then be prepared with a weak solution of nitric acid and alum, or sulphuric acid, to finally dissolve out strong, fatty-acid compounds and to neutralize the caustic



MACHINE FINE GRAINED ZINC, MAGNIFIED 250 TIMES.

MACHINE COARSE GRAINED ZINC, MAGNIFIED 60 TIMES.



MACHINE FINE GRAINED ALUMINIUM, MAGNIFIED 60 TIMES.

MACHINE FINE GRAINED ZINC, MAGNIFIED 60 TIMES.

soda. The nitric acid, alum and water bath may be used for this purpose also. A good wash under a flow of hot water will give a clean plate. But it must be remembered that any treatment of the plate with nitric or sulphuric acid dissolves a part of the plate, more especially the fine points of the grain; and if the grain for the next drawing must be a fine crisp one, then it is necessary to re-grain. If re-graining is necessary, the treatment with turpentine, followed by caustic soda, is sufficient prior to re-graining.

There is another method of preparing zinc plates which is simple and very effective. The work is washed off with turpentine, followed by caustic soda. The soda must be applied until all traces of the greasiness of the old work have been eradicated. Then make a solution of:—

Alum	1 oz.
Boiling water	1 quart.
Add nitric acid	¼ oz.

This solution may be poured on in a thin film and allowed to dry. It dries quickly and the plate is ready for use.

CHAPTER VI.

Zinc. Treatment in the Press.

HAVING treated upon the graining of metals in which there is in some respects a similarity, the two metals will be taken separately to prevent any parallel comparisons causing confusion.

New zinc plates should be rubbed all over with pumice powder and felt pad. Drawings can then be executed upon them in crayon alone, or ink and crayon, and transfers be run down upon them. In using crayons or ink, the soap and fat which they contain do not take so readily to the metal as they do to stone. To assist the chemical combination chemical means must be employed. Especially is this necessary both in using crayon upon zinc, stone or aluminium, because the soap in the crayon must be decomposed and the resultant acid or acids unite with the printing surface to form an insoluble compound before any amount of water is used on the plate. The chemical change is effected by an etch or treatment with some acid which will act upon the soap. Upon stone, nitric or tannic acid may be used. For zinc, nitric acid must not be used but gallic or chromic acid is available. The etch may be prepared as follows :—

Soak 1¼ oz. gall nuts in 1 pint of water; after 24 hours' soaking, boil the solution; allow to cool; strain off the nuts and dirt. The filtered solution contains the gallic acid.

To mix the etch use :—

Gall-nut solution...	¾	pint.
Gum solution, ordinary strength ...	¼	,,
Phosphoric acid	2	drachms.

This etch is brushed all over the plate with a flat camel hair brush and allowed to attack the ink. When apparently used up, more may be put on where the crayon exists in thick masses. Finally wipe it off roughly and gum up the entire plate, which may then be allowed to dry. Another etch may

be prepared by using a strong solution of tea, in the same quantity and in place of the gall-nut solution, with the gum and phosphoric acid. Another etch may be made of:—

Gall-nut solution	...	...	...	⅓ pint.
Nitric acid	...	...	...	¼ oz.
Acetic acid	...	...	...	4 drops.

But this cannot be recommended in place of the above, with phosphoric acid.

Possibly the best etch is that advised for use with the patent litho plate in 1885-6, consisting of potassium bichromate and gum. To prepare this, dissolve 1 oz. of potassium bichromate in 20 ozs. of water. Take, say, ¼ pint of this solution and mix with ¼ pint of gum solution of the ordinary strength.

Another form of this etch is apparently that supplied for the Parker plates. The etch is in two bottles: No. 1, probably phosphoric acid; No. 2, apparently a strong solution of potassium or other bichromate, or chromic acid. Of these, use 1 oz. of each in 16 ozs. of gum solution of ordinary strength. Horsell's also supply a powder etch under the name of the "P.P.P." etch, which is apparently a mixture of the above two materials.

In all cases the etch is to be laid on the work with a large flat brush, treated locally with more "etch" where necessary, roughly wiped off, gummed over and allowed to dry. If desirable the plate may be placed in a large dish, the etch poured in and rocked over the plate, as done with stone some 50 to 60 years ago.

The gum having dried, there are alternative ways of washing out. The gum must be left on the plate, and the actual work washed out on top of the dry gum with turpentine. This leaves the work bare and clean to receive the ink. Instead of turpentine, an effective washing-out liquid may be used. These liquids can be prepared as follows:—

> Place a quantity of crayon parings in a bottle large enough to hold 1½ pints of turpentine; add 1 pint of turpentine; shake up well and allow to stand. If the crayon parings are all dissolved, or nearly all dissolved, add more so that the solution may be a strong one. After some hours, best gauged by experience, strain off the liquid and add 1 oz. of sensitive bitumen or asphaltum. Shake up well and allow time to dissolve.

In houses where crayons are largely used this is the cheapest method of preparation, and the liquid produced is one of the best.

Another similar liquid may be made thus :—

Soak a quantity of good beeswax in 1 pint of turpentine until it is saturated ; strain off the liquid and add one ounce of sensitive bitumen or asphaltum.

This liquid can be prepared by any printer. The sensitive bitumen can be obtained at any photo-process supply house.

Having washed out the drawing with either of these two last "doctors," the work has become so firm and so sound that it may be relied upon to print. In the older method, when the work was washed out with turpentine only and rolled in solid, it was customary to sprinkle with water and to continue to roll up until the work came out sharp. But such a method resulted in filling the roller with a mixture of gum and water, and it was necessary to scrape and wash up afterwards. It is better and cleaner to take some clean rags, and bit by bit wipe off the gum and ink until the work is practically clear. When using a "doctor" for washing out it does not require rolling up solid, but can be washed off at once.

Having obtained a clear plate it is then necessary to roll up and etch, as is done with stone. If the potassium bichromate etch has been used, and the plate wiped clean, there will be very little cleaning up necessary. The potassium bichromate is most effective in killing all the scum and finger marks, as well as being an effective etch for the original drawing. It should be remembered that in getting the work "into" the zinc, there has been greater difficulty than with stone. The metallic soap formed is not so active as with stone, and it is more often the effect of the grained surface of the zinc, rather than a strong chemical affinity, which causes the zinc to catch bits of ink, grease or varnish on the surface. The second etching, therefore, should in some way affect the metal, either by wearing down the face a little smoother, or by glazing the surface to prevent, as far as possible, catching of the ink by the grain, and the formation of greasy spots. Of the etches in use there are three well known. The first is the gall-nut solution, gum and phosphoric acid, of about double the strength of that used for etching original drawings. The second is

virtually the same, only that it can be made up from prepared gallic acid. It is a mixture of :—

Gallic acid	...	...	...	1 oz.
Phosphoric acid	...	...	...	½ ,,
Gum solution	...	...	...	1½ pints.

In this case the quantities given are not limited, and may be altered within reason.

But in both these cases the nullifying effect on the zinc surface is not of long duration. It requires frequent repetition to keep a clean plate. The third etch is a reminder of the attempt made years ago to secure a glazing of the surface by treating with potassium oxalate solution.

The new etch is made up of :—

Ammonium silico-fluoride	...	...	1 oz.
Ammonium nitrate	...	...	1 ,,

Dissolved in hot water, 24 ozs.

This etch no doubt attacks the zinc and for a time forms an effectual non-metallic glaze on the surface.

The second etch having been completed the plate is ready for use. It may be added that both for the first etch and the second etch one solution may effectually be used, varying the strength as required, viz. :—

Gum solution	...	...	...	1 pint.
Phosphoric acid	...	...	...	½ oz.

In all cases where gum is used, one or two drops of carbolic acid (Calvert's No. 2) should be added to each pint of gum to keep it from turning acid.

Having obtained good sound work on the plate, it may require cleaning. The spots of grease amongst the work are most effectually removed by treating with solution of caustic soda, using wooden stumps or quill. Scraper or polishing stone should not be used. Large areas of dirt may be removed by turpentine and the phosphoric acid (1 oz.) and gum (1 pint) solution. In fact this solution is effectual in keeping down scum. The potassium bichromate and gum solution used for the first etch is perhaps even better for keeping down scum both on zinc and stone, if it be allowed to remain on a minute or two and then washed off.

In rolling up for proving, and in machine work, there is no solution so effective as strong tea for keeping the plate clean.

If tea solution be not available, a weak solution of caustic soda will always keep the edges clean. Scumming may be also removed by weak acetic acid, and this treatment also freshens the surface of the zinc, giving it a brighter appearance. But acetic acid, sulphuric acid, or the mixture of alum water and nitric acid, all have a tendency to thicken the work.

In the earlier days of zincography it was generally considered that, in printing in colours, the various metallic, non-metallic and organic pigments were affected in colour by contact with the zinc. This may have been so when less pure zinc was used, or before phosphoric acid was introduced into the etches. But for the last 40 years the matter has not been seriously taken into account. The pigments are so well ground into varnish that every particle is practically surrounded by a film of varnish and never comes in contact with the zinc. However, the use of the potassium bichromate and gum etch, and subsequently the treatment with the ammonium silico-fluoride solution, have made zincography as simple and as easy as working from stone.

Ordinary lead pencil should not be used for marking the lay, &c., on zinc, as it takes ink. In its place use a thin silver coin, or have a piece of silver wire mounted like the lead in a pencil.

CHAPTER VII.

Zinc—Treatment in the Press.

Transfers, Off-sets, Transposition, Alterations and Additions.

Transfers for zinc should always be pulled a little fuller than for stone. They may be put down upon either dry or damp plate. If the paper must be damped, the stone supporting the zinc may be warmed to impart a little warmth to the plate. By using the recently made French ever-damp transfer paper much trouble is saved. It is unnecessary to moisten the plate with turpentine before putting a transfer down. Such a course may be resorted to for very old dried transfers. But if there is any doubt as to the freshness of the plate, or the weakness of the transfer, it is advisable to treat the plate with the solution of water (1 quart), alum (1 oz.) and nitric acid ($\frac{1}{4}$ oz.), which makes it highly sensitive. Many excellent transfers have been secured by this treatment.

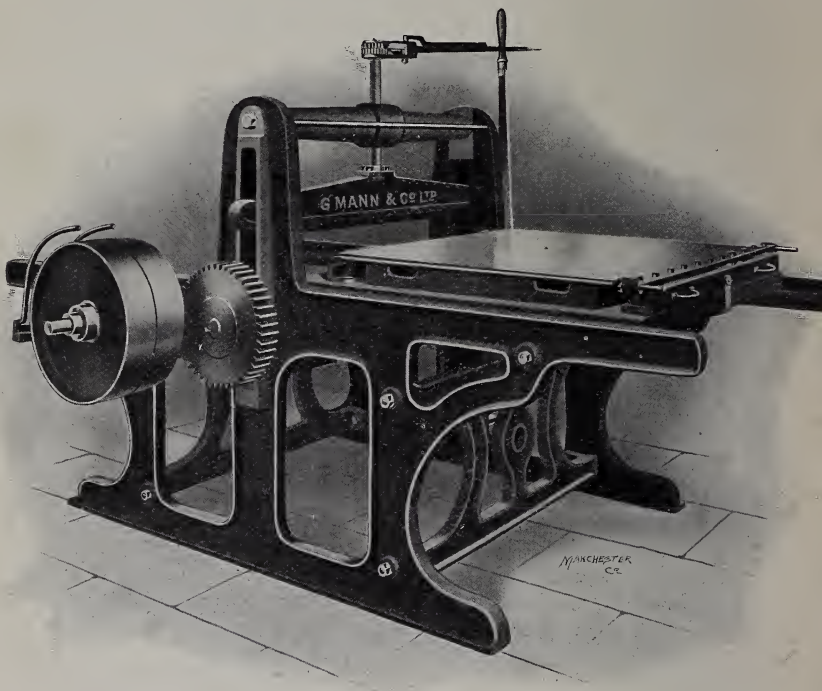
Transfers of all kinds can be put down to zinc. Copperplate, lithographic writings, autographs and crayon work are all equally suitable.

The difference between treating a transfer and an original is to omit the first etch. The method is to gum up, allow to dry, and wash out the work on the dry gum with a "doctor" or washing out liquid. The etch used subsequently should be the gallic acid (1 oz.), phosphoric acid ($\frac{1}{2}$ oz.) and gum solution ($1\frac{1}{2}$ pints).

In putting down transfers, especially from copperplate, it frequently happens that a large amount of scum is present. This is only a surface film, and if carefully rubbed off with pumice powder and a sponge or tuft of cotton wool, is effectually removed. Whitening, or other fine absorbing dust, may be used in the same way. Even though the actual work is rubbed at the same time, if due care is taken the work is not appreciably affected.

Alterations and Additions.

In order that alterations or additions may be made on zinc plates, the plate must be cleaned. If an addition only is to be made, the plate may be cleaned after washing off the gum with a weak solution of sulphuric acid, used carefully and



Broadway Transfer Press.

expeditiously. Acetic acid is almost as effective. The plate must be washed well with water, and then treated with either a solution of alum, or the alum, water and nitric acid solution. The plate is then perfectly clean and ready to draw or transfer

upon. Newly drawn work may be rubbed off the plate with india-rubber or ink eraser.

In cases where work has to be removed, the grease is eradicated by abrasion with pumice powder and a wooden stump, or by treatment with turpentine followed by caustic soda, washed and re-prepared with either the alum solution, or alum, water and nitric acid solution.

In all cases the cleaning of zinc after the alum, or acid-alum water, before drawing or transferring upon is best done by scraping pure chalk or whitening on the plate, sprinkling with water, and gently rubbing on the plate for a few minutes, then washing off with clean water. Treating the plate with acetic or sulphuric acid, or the alum, water and nitric acid mixture as indicated above, are liable to thicken the work, if not followed by the whitening to neutralize the acids.

Benzine is one of the strongest solvents of grease in the plate. It may be used instead of turpentine. The frequent failures in taking work out of the plate are due to hurriedly putting on the caustic soda, and washing it off before it has neutralized the work, which is a fatty acid compound with the metal.

Transposing.

Transposing upon zinc can effectively be done by drawing the work with Indian ink and gum. When dry cover with "doctor," and treat as for original work. The work may be drawn with a medium of silicate of soda, and any ink. When dry, cover with "doctor," as above. This method possibly gives the best results.

When work already existing has to be transposed it must not be attempted on the same plate. A new plate may be covered with a thin film of Roderzone and dried. The film should be evenly spread and kept very thin. An impression of the work should then be run down on the plate. Such impression may be in transfer ink. The work on the plate should be rolled up and well dusted and thoroughly covered with talc. The plate may then be cleaned with alum solution, or alum, nitric acid and water, and finished with whitening. When clean and dry cover with litho draughtsman's ink, mixed thick, and treat as original work. The Roderzone under the impression will ultimately dissolve and the work will come away quite clean. But the manipulation takes much longer, and is not so certain

in its results as when done on stone with potassium oxalate. It is, therefore, preferable to transfer a transposition already made on stone, to zinc, when required, rather than making a transposition on zinc.

Off-sets.

Off-sets upon zinc can be put down with a mixture of red chalk and a small amount of vegetable black, using a light brown glazed paper, or steel blue or flint paper.

The off-set may be made more permanent by using a mixture of :—

Aniline mauve	...	...	...	5
Magnesia	...	...	...	5

They can be run down on a slightly damp plate, or, if care be taken, the plate may be moistened with turpentine and a few drops of carbolic acid. This will give a permanent off-set.

It is necessary for red chalk off-sets that the zinc be damped with turpentine before running them down. On "prepared" zinc plates the use of turpentine is generally unnecessary, a little wash of water is sufficient.

A method of putting down off-sets which scarcely recommends itself is to damp the plate with turpentine and run it through with clean paper, then put down an impression from the key in coloured aniline ink on plate moistened with methylated spirit, when the aniline colour will alone become the off-set.

There are now several off-set powders manufactured which give good results. See Recipes 113, 114.

CHAPTER VIII.

Printing from Zinc.

THERE is very little to add to the previous chapters in dealing with the actual printing from zinc. When the presswork has been mastered the same principles must be applied.

Although in the first place it is difficult to get the work well established in zinc, yet when once there it remains good, and the mechanical character of the grain tends to accumulate scum. In the mixing of the ink it must be thoroughly well ground, and the necessities of chromo printing require that tints must be used with thin varnish. The varnish has a strong tendency to cling to the plate. If the etch has been by potassium bichromate and gum, and after rolling up, the plate has been treated with ammonium silico-fluoride mixture, very little trouble should arise. An occasional treatment with the latter solution will continue to keep the plate clean. If this be not used then tea solution must be regularly used for damping. Even a watery solution of golden syrup will act almost as well. If under any such treatment scum should appear it can be removed by acetic acid, or, if necessary, caustic soda. Caustic soda is invaluable for keeping the edges of the zinc clean, and in treating the plate in the press it often happens that the processes are faulty, because the gum has been put on too thickly, and dried so that the washing out is hindered.

The most important point in printing from zinc is mounting the zinc properly on a stone or bed plate. In a press the zinc will remain steady upon a damp stone, or a sheet of thin damp paper may be placed on the stone and the zinc laid upon it. In the machine the means of mounting must be more certain. In many houses zinc is mounted over a stone, being bent down the front and back edges and held by the blocks in the carriage. It may be simply bent with a slight incline and nailed to the blocks, or it may be bent down and fastened by the blocks against the stone at the gripper edge, the front edge being only bent down with a small incline so that it does not rise in the forward movement. When using a stone place a layer of

waterproof elastic bedding flannel under the plate. It is better, however, to use the iron bed plates now so commonly employed. The improvements in these bed plates leave little to be desired. Bed plates are made with one long gripper on one side, which holds the plate to the bed, and a long double gripper at the other side, into which the other edge of the plate can be clamped, prior to forcing it away from the bed by screws, thus drawing it tightly over the bed. This movable gripper may be made with only a slightly inclined jaw to take thick plates without much bending. Another variation of these clamps or grippers is to have them divided into two, three, four or five small clamps so that the plate is gripped only at intervals. This is applicable to all plates, and is especially useful when the edges of the plates are somewhat wavy. In mounting plates on stone or bed plate the surfaces underneath in contact must be scrupulously clean; the smallest grain of sand or fabric will ultimately raise a point in the plate.

Before actually commencing to print run the machine with clean paper, and get the plate stretched and settled in position, then tighten up the locking and stretching nuts. At any time when printing is stopped for any interval always gum it up thinly.

For long runs of fine work zinc may be etched into low relief, in a similar manner to stone. A strong "rosin etch" is given, using an etch of nitric acid 1 part, water 30 parts. The rosin may be melted into the ink with moderate heat. In this respect zinc is much more suitable than aluminium.

A writer in *Allgemeiner Anzeiger für Druckerein,* in 1906, states that when zinc plates have been scoured with acetic acid, and the etch used has been saturated alum 25, thick gum 75, nitric acid 3 to 5, they not only give a good water absorbing surface, but the plates do not oxidize.

Preservation and Storage.

Zinc plates have been so long in use that the following three methods of preserving them need be but briefly outlined. The work on the plate should be rolled up in good transfer ink, dusted with talc, or better still with the transfer preserving dust obtainable from sundrymen, then gummed up evenly with good gum arabic solution containing a few drops of carbolic acid (Calvert's No. 2) and dried. When dry they should be stored in pigeon holes in wooden cupboards and kept dry.

They may be perforated and hung on long nails; so long as they hang loosely with a free circulation of air they remain good; or if they are originals may be kept in wrappers, as copperplates are kept.

The use of zinc plates for originals cannot be too highly recommended. They will apparently withstand much rough usage providing they do not get wet or come in contact with damp metals. When plates thus put away are required they will usually roll up without much trouble. If there is any difficulty in washing it out, it is necessary to cover the plate with turpentine and sprinkle on a few drops of carbolic acid (Calvert's No. 5), which will almost instantly commence to dissolve the old ink. After rolling up and as soon as the plate is in a fit state to manipulate, treat it with the potassium bichromate and gum etch, followed by a good rolling up and, if necessary, a final treatment with etch before printing.

Zinc plates may be treated as aluminium plates are, by rolling up well, drying quickly, gumming thinly and drying well. Then wash out with a "doctor" and leave the film all over the plate. In some cases this method is carried a little further by washing off the gum and film of "doctor," drying the plate thoroughly and again gumming up evenly. The plate should be dried quickly after the last gumming up.

When such plates are required for use they should be re-gummed before washing out with "doctor." If the old dry ink still refuses to be dissolved, it must be gently removed by treating with turpentine containing a few drops of Calvert's Carbolic Acid, No. 5. On no account attempt to remove the ink by harsh measures, such as the use of salt; no abrasion should be necessary if turpentine and carbolic acid be used. Work of at least ten years' standing readily surrenders to this treatment.

To preserve zinc plates with work upon them, there is another method recommended, to gum up upon the clean dry plate with gum and potassium bichromate (5% sol.). Of the latter add only a little. When "gummed" fan dry and expose to light to harden for about half-an-hour; finally gum over with new pure gum solution containing a few drops of carbolic acid No. 2. When required for use, dissolve the gum layers with water containing 1 to 2% phosphoric acid. But such a method is a doubtful one and should only be used when the storage is likely to be damp.

CHAPTER IX.

Aluminium—Treatment in the Press.

THE treatment in general bears several similarities with zinc, but the two metals differ in their chemical affinities and must be treated accordingly. All plates must be scoured with pumice powder and felt pad before drawing or transferring on them.

There is perhaps no drawback in the use of aluminium so great as its rapid deterioration or oxidation in air, and especially under the slightest traces of water. A plate once oxidized is scarcely fit for anything except re-graining. To prevent oxidation when using water or gum under any circumstances during processes which terminate in drying, always dry quickly, either by rapid fanning or in front of a fire. In the machine work, at every stoppage raise the dampers, so that they cannot touch the plate, gum up the plate and dry it quickly. Unless this is done an insensible scum will arise all over the plate, gradually becoming visible and ultimately darkening the plate and the print practically beyond remedy. If the scumming be noticed in its very early stages it may be checked with the strong etch—gum water, 30, and phosphoric acid, 1—rubbed on with felt dabber. In extreme cases the etch may be reinforced by using pumice powder. But such strong measures must be used with the lightest hand manipulation, for there is nothing more detrimental to aluminium than scratches. It is for this reason that scrapers should never be used for effacing work on aluminium.

Original work on aluminium, whether a drawing in ink or crayon, must be etched as with zinc, but the work must be well dusted with talc before etching. The etch for originals consists of:—

Gum solution	12
20% sol. phosphoric acid	1

or

Gum water (15° Baumé)	70
Syrupy phos. acid (45° B.)	1

To assist this action the plate may be warmed before dusting with talc. The etch may be laid on with a fine flat brush, or a sufficient quantity may be placed on the margin of the plate and spread over it with a soft sponge. Local etching should be done with a smaller brush. The etching being completed, the surplus may be taken off with the sponge. Finally it should be wiped all over with a gum sponge and dried, the drying being assisted by heat.

The gum having dried, the whole of the work must be washed out on top of the dry gum with a "doctor" or washing-out fluid, prepared as shown in Chapter VI. After it has been allowed to evaporate, wash off the gum, roll up in black ink, dust with talc.

To clean the plate, first remove as much dirt as possible with india-rubber. Strong spots or lines can be removed with a mixture of caustic soda and water applied with a quill, just as the acid stump is used on stone, following at once with the gum sponge, and squeezing the caustic out of the sponge frequently.

or

Terra di Siena	1
Oxalic acid	2

or Sulphuric acid,

dissolved and mixed in sufficient water to make a strong solution. This is applied with a brush or quill. Having cleaned the plate, etch with :—

Gum solution	8
20% sol. phosphoric acid	1

or

Gum solution (10° to 12° Baumé)	30
Syrupy phos. acid (45° B.)	1

Sponge the etch well over the plate and keep the film of etch thin. Soak it up with the sponge and finally gum up with pure gum, using a sponge and leaving only a thin film. To ensure that the gum is thin, wipe the plate with a cloth damped with clean water. The gum having dried, it is ready for proving. The gum is washed off, the work washed out with turpentine, and rolled up in the necessary ink. In working upon aluminium

plates the greatest care must be exercised in using sponges and cloths quite free from grit—the softest sponges being used with the coarser grained plates and swan's skin, or swan-down or molleton for the smoother plates.

In rolling up, the ink for each impression must be as fresh as possible; for this purpose large rollers should be used, and the slab frequently cleared of any dirty ink. Spots of water which have dried must be gummed over and removed with the transfer etch of gum 8, phos. acid 1, or the gum 30 and phosphoric acid 1.

In printing from aluminium the printing ink should be kept as stiff as possible; if the ink be a tint, the addition of a little magnesium carbonate, silicate of soda, even glycerine or gum arabic, will tend to stiffen the ink and prevent scumming.

CHAPTER X.

Aluminium—Treatment in the Press.

Transfers.

Transfers for aluminium must be pulled in a good strong ink, and a little fuller than for stone. They can be put down to either dry or damp plates. In all cases the plate must be scoured with pumice powder and felt pad before transferring. It is doubtful whether aluminium should not always be treated with some alkaline wash before work is put upon it. It should be remembered that alum has properties in some respects similar to soap. They each dissolve and decompose grease. So that aluminium with an alkali may, in themselves, form a species of soap of the same peculiar insoluble kind as the oleo-margarate of lime formed by fatty acid with the alkaline metal calcium of lithographic stone. But if that be so the acid action most probably proceeds from the aluminium, and combines with the alkali of the soap used in the crayon and ink. It has already been shown in Chapter II that aluminium will form compounds with the alkalis; and that both potassium aluminate ($Al_2K_2O_4$) and sodium aluminate ($Al_2Na_2O_4$) are known to chemists. As such compounds do occur, there is no reason why, in the case of soapy crayon or ink being applied to aluminium, the subsequent etch should not break up the soap, and in that action separate the alkali in such a nascent condition that it forms an aluminate of either sodium or potassium, or both, according to the nature of the soap used. These inferences give strong support to the suggestion that before a transfer is put down the plate is more active if washed over with ammonia solution. This is not only a suggestion, for it has been put into practice and found satisfactory. It is not uncommon to smear a stone with turpentine before transferring on it. The idea is to quicken the activity of the grease by minutely separating its particles, and to some extent this analogy bears upon the treatment of aluminium with an alkali.

The alkali more or less separates the fatty acid and alkali in the crayon or ink, and, whilst partially combining with the fatty acid, liberates the alkali to form the aluminate with the plate. This treatment having been partially adopted it should be experimented with, and may ultimately prove of considerable value in alumenography.

If no alkali wash be first given to a plate, then every care must be exercised in getting down a good transfer. The use of partially damp paper and a dry plate is most effective, but when the composition is naturally hard by the presence of gelatine, it is necessary to damp the plate. It must always be remembered that too much water on the plate frequently prevents a transfer going down; hence has arisen the suggestion to use an alkaline solution for the damping. In running down a transfer it is advisable to use some six or eight backing sheets. It is strongly recommended that in all transfer ink used for aluminium plates a small amount of carbolic acid in the form of Calvert's Carbolic No. 5 should be added. The transfer ink itself should be mixed with a larger quantity of printing ink than used for lithographic work. The transfer having been run down as in lithography, it should be damped off with warm water, well rinsed until quite clean, and fanned dry quickly. At this stage, the plate being quite clean, any drawing with crayon or ink may be made.

If new drawing has been added, the plate is gummed up and fanned dry. The film of gum must be thin. The plate can then be put aside for a day or so, much to its advantage. In fact it is advisable never to hurry plates from the press to the machine. The plate is next washed out on the dry gum with "doctor," which is allowed to evaporate. Proceed to clean off the gum with water until the work is clear, roll up well, dust with talc, then etch with :—

Gum solution	12
20% sol. phosphoric acid	1

using a sponge and executing the etch quickly. Having again gummed up the plate and dried it quickly, wash off the gum and wash out with turpentine before rolling up and cleaning the plate. Roll up the work well in an ink containing transfer ink, and if it fail to come up properly as a whole, rub it up carefully. If only a few lines here and there show weakness, they may be firmly drawn upon with a hard lead pencil—6 H—and

subsequently brought up by dabbing with ink on the finger. The cleaning away of dirt may be done with india-rubber, or pumice powder and felt stump. The greasy spots should be removed with caustic soda solution and a quill as already described in the last chapter. If parts of work or large masses of dirt require removing use sulphuric acid with a glass brush. Both sulphuric and oxalic acids are useful for cleaning away greasy dirt. When quite clear, dust with talc and give an etch with :—

Gum solution	8
20% sol. phosphoric acid	1

or

Gum water (10 to 12° Baumé)	70
Syrupy phos. acid (45° B.)	1

The etch should be sponged over quickly, well washed off and the plate quickly dried ; finally, gum up thinly and proceed to prove by washing out with turpentine, or a weak "doctor," and rolling up in the desired colour or black for machine or press.

The treatment so far concerns transfers taken from plate or stone from work already existing. But for transferring original drawings upon transfer paper a few details must be dealt with. Good transfer paper should be used with either gelatine or commoner glue or starch in the composition. But in all cases it is advisable to damp the transfer in the damp book until the ink looks shiny, then put it down to plate—a warm plate being advisable. The transfer ink used should be good or freshly mixed, and it will most probably be unsatisfactory to attempt to put down an old transfer. In damping transfers to assist the ink, the damping must be continued until the ink appears shiny. This may necessitate long damping, and, when that is the case, the transfer must be laid out a little while to dry somewhat before it is put down to the plate. Any attempt to put down an old transfer must be done on a warm plate. To transfer autograph writings the ink must be good and not too old. The aluminium plate should be placed on a warm stone. The "writing" must be carefully damped in the damp book, and no excess of moisture should appear. If the plate has not been treated with carbonate of soda and water, it may be washed over with sulphate of aluminium. A backing sheet just barely moistened with turpentine may be laid on the writing when transferring. When transferred, treat as a transfer to

aluminium, as already described. When "autograph" transfers are to be put down it is advisable to cut a few holes through the paper at blank spaces, then when it is first run down put patches of gum paper over these holes, or mount upon transfer paper by using a sheet of damped transfer paper as the first backing sheet, thus causing the paper to adhere and allowing it to be run through several times. For autographs it is advisable to damp the plate slightly with turpentine before putting down.

Having used plenty of backing sheets, with all the necessary back-damping, the transfers will generally peel off in a semi-dry state. If more soaking off be necessary use slightly warm water. When all the paper and composition have been cleared off, fan dry quickly, gum thinly, and dry. At this stage slight additions and even strengthening of lines may be done by drawing through the gum with a 6 H (hard) lead pencil, so as to expose the aluminium. These lines may even be scratched with a steel point or pen, and in either case a little good printing ink may be dabbed in to make them firm. As this is a transfer of new ink work it may be washed out with a "doctor," which must be allowed to evaporate, then with gum water wash off, roll up well, dust with rosin and talc, and etch with :—

Gum water (Baumé 10° to 12°)	70
Syrupy phosphoric acid (Baumé 45°) ...	1

followed by clearing off the etch with a gummy sponge, then gum up thinly with the gum sponge, wipe off with a damp cloth and fan dry quickly. The work may now be rolled up, after washing out with turpentine, and proved, the plate being cleaned as already suggested.

In transferring of all kinds there are many essential points which may be shortly enumerated as follows :—

Use anti-damp or ever-damp transfer paper as often as practicable.

When coated transfer papers are used, moisten the plate thinly and evenly, just before putting the transfer down, with an alkaline solution of :—

Bicarbonate of soda	1
Pure water	30

This must be put on the plate with perfectly clean linen rags, which have been boiled for five or six hours in

two or three changes of clean water, and dried in a dust-proof room.

The temperature of the room should not be less than 70° F.

Transfer ink should be stiff. For drawings on paper it should be mixed thick. For pulling transfers it should be composed of half good transfer ink and half good printing black ink and worked stiff.

The grain of the plate must be suitable to the quantity of ink required for printing, and accordingly commensurate to the damping, the fine work on a fine-grained plate, and heavy work on a coarser grain.

Transfers must not be too bare, nor must they be too greasy. Old transfers require special care in damping in the book, and drying a little afterwards before putting them down.

Too much water on the plate, or in the transfer after damping in the book, will cause broken lines.

Dirty or greasy rags; excess of alkaline solution; and the old work on the plate coming back will all give scum.

When rolling up for an etch it must be rolled up full, then dusted with rosin and talc before applying the etch; the etch should not remain on the plate longer than it is allowed on stone.

The excessive use of the "doctor," with careless treatment, results in scum rising.

CHAPTER XI.

Aluminium—Treatment in the Press.

ALTERATIONS AND ADDITIONS, OFF-SETS, TRANSPOSITIONS, STORAGE.

ALTERATIONS AND ADDITIONS.

To make additions of a rough or minor character, such as strengthening weak lines, or adding a strong line or dot here and there, the simplest procedure is to gum the plate thinly, dry quickly, and then cut through the gum with a 6 H lead pencil so as to bare the metal. Into these scratches rub some good printing ink, or mixture of half transfer and half printing inks, or the "doctor."

To add matter of a more or less delicate character, the plate must be cleaned either locally or all over. The difficulty of adding work without previously removing the old work is one which has not been too well solved. It is possible, however, providing the greatest care be exercised, to accomplish it.

In all cases when alterations and additions are to be made, the rolling up of the work must be done with a good stiff ink. Then it must be well dusted with talc. There are various methods of cleaning the plate thus left bare. It being well known that nitric acid decomposes gum, and virtually destroys it as gum, it is advisable to treat the plate with a two per cent. solution in water to free the surface from gum. But as the work and the plate have previously been treated with gum and phosphoric acid, thereby forming a salt of the metal which adheres to the surface, a solution must be used to decompose that salt. The mixture is composed of:—

Saturated sol. of oxalic acid	4
Pure nitric acid	4
Distilled water	90

This solution must be applied with a soft pad or a fine glass brush carefully on those parts to be cleaned: it is better that

it should not go on to the work unnecessarily. In cleaning a fine grained plate the time of application of this solution should be about three minutes, and for the coarse grain about five minutes. Having cleaned the plate, wash well with water and dry quickly with blotting paper or tissue paper, not with a cloth. The drying must be done by direct dabbing down upon the moisture. The final drying is done with a fan. The metal is then clean enough to draw or transfer upon. Another method, which is so effective upon stone, is to roll up well as already described, treat with the 2% solution of nitric acid, wash and dry off quickly. Then scrape whitening upon the surface, sprinkle with water and rub the surface of the plate with a felt stump for about two or three minutes. This generally proves sufficient; but to be quite sure, treat the surface carefully with the alkaline solution—3% bi-carbonate of soda in water. Then wash off, dry quickly, and execute the drawing in ink or crayon, or put down the transfer.

When the additional work consists in a complete alteration, then methods similar to cleaning an old plate, as already described in Chapter V, under aluminium, may be employed. The method is, briefly, to remove work with turpentine or petroleum and a little pumice powder, followed by benzine, and finished with the nitric and hydrofluorsilic acids and water, the greatest care being taken not to scratch the plate. This method, however, is cumbersome and not expedient in most cases. A more simple method is to roll up well as already described, clear off the gum, and proceed to apply concentrated sulphuric acid, with the glass brush, to those parts to be removed. When the work has been eradicated, wash well with water, dab off the surplus moisture with blotting or tissue paper, and prepare the surface for the new work with weak oxalic acid, or with the oxalic and nitric acids and water mixture, diluted with more water. Dab the plate and fan dry quickly, when the new work may be added.

This method may be carried out with another variation. Instead of rolling up well and dusting with talc, the plate may be gummed thinly and the work washed out with "doctor." When that has evaporated the gum must be all washed off, and the parts of the plate where new work has to be drawn are cleared of old work with concentrated sulphuric acid. Or the mixture of Terra di Siena and oxalic acid well

diluted may be rubbed over with a felt stump, instead of sulphuric acid. After about three minutes application in either case the plate is well washed and the solution of oxalic and nitric acids and water allowed to remain on the plate for about five minutes; the plate is then well rinsed and dried quickly. New work can then be drawn in ink or crayon, or transfers put down.

After any of the above processes have been completed and the new work added, the plate must be treated as for new original work. The work must be dusted with talc, etched with either gum solution 12, 20% phos. acid 1, or gum water 70, syrupy phos. acid 1, the etch remaining on the plate half a minute, and the following procedure as already described in Chapter IX.

It may be added here that Dr. Strecker's special etch, known as Roderzone No. 3, consisting of a powder of which 5 ozs. should be stirred into one gallon of cold water for two or three minutes has proved very effectual when used as the second etch for originals, and the etch for transfers on aluminium.

Off-sets.

Off-sets upon aluminium must be treated with more care than for stone or zinc. The ink used for pulling the impression must be as free from surplus grease as possible, as the slightest trace will ultimately come up on the plate. The off-set impression should be pulled on a smooth, well-calendered paper—not necessarily hard sized or non-absorbent. If the paper be slightly absorbent there will be less opportunity of the grease of the ink going down to the stone. The off-set powder should be made of:—

Terra di Siena	2 parts
Frankfort black	1 part

Bronze blue may be added in small quantity or even substituted for the Frankfort black.

The off-set may be made more permanent by using a mixture of:—

Aniline mauve	5
Magnesia	5

They can be run down on a slightly damp plate, or, if care be taken, the plate may be moistened with turpentine and a few drops of carbolic acid. This will give a permanent off-set.

Preservation and Storage.

Before putting away aluminium plates, roll up quite firmly, fan quite dry, dust with talc, and gum evenly and thinly. On top of the gum wash out with a "doctor" and leave the film of "doctor" all over the plate as a protector. The thin film thus left is a poor protection and may prove ineffective. Each plate should be wrapped up in paper, and stored separately in a dry rack in a cupboard. No injury will result from packing up all plates of one design separately in paper, and tying them all up together.

When these plates are again required, they should be gently warmed, then washed out with "doctor," before damping off the gum and rolling up. A good rinse of water with a spray after removing the gum is also beneficial.

To all gum used for putting plates away, whether for a day or two or for months, always add a few drops of Calvert's Carbolic Acid, No. 2, to prevent the growth of fungus.

It is recommended that the work should be rolled up in a special preservation ink, consisting of:—

Spermaceti	4 ozs.
Beeswax	6 ,,
Good litho ink	4 ,,
Olive oil	1 ,,
Glycerine	½ ,,

Transposing.

Transposing upon aluminium is perhaps one of the easiest and most curious manipulations in the whole treatment of this metal. Use a fine-grained plate, and roll it up solid with transfer ink, or draughtsman's ink reduced in turpentine. Pull a good impression from the subject to be transposed in good printing ink on smooth transfer paper and dust with finely powdered oxalic acid, as though it were an off-set. Lay this transfer off-set face up on the damp book for a few minutes and then lay it on the inked face of the aluminium. Pull it through to make it adhere; remove the transfer paper; then pull through with a slightly damp backing to pick up the excess of oxalic acid. Rinse well with water under the tap, when it will be found that the oxalic acid has killed the transfer ink on the plate and has produced an almost perfect transposition. The plate is dried quickly; it may be damped and rolled up and etched

with the weak etch slightly, then rolled up again, etched and gummed ready for proving.

The action of the oxalic acid is so drastic as to draw a clean line of demarcation between its use upon stone and zinc, as against its use on aluminium. The action which takes place may lead many printers to use oxalic acid in varying strengths in other useful directions.

CHAPTER XII.

Printing from Zinc and Aluminium.

In addition to the numerous references to printing from zinc and aluminium which have been made in the preceding chapters, there are some items which are more or less confined to machine work. It is frequently desirable to etch work into relief when a long run of fine work is required.

The method of etching for zinc is practically the same as for stone. The work is rolled up ready for printing, it is then dusted with a resist such as talc. The plate may be etched into relief with nitric acid and water. The acid should be very weak at first, so as to remove the surface of the zinc and form the first step of the pyramid the apex of which bears the actual work. It is well to wash off and examine the plate after three or four minutes to see that no undercutting is taking place. The etching may be continued until sufficient relief is obtained. After the completion of the etch, treat with the ammonio-fluoro-silicate, or Roderzone No. 1 solution to give a water-absorbent surface.

For aluminium the initial stages of getting the work on the plate are as already described. For etching into slight relief the work is rolled up and dusted with a resist such as rosin and talc, or asphaltum, and the etching carried out with a saturated solution of hemi-chloride of copper, to which is added a solution (prepared with acetic acid 6 and water 10) until it turns the deep green copper solution to a light blue tint. Before etching damp the plate all over the front. The action which takes place is deposition of copper and liberation of hydrochloric acid; the latter attacks the plate. The action must be watched and rinsed off well with water after a few moments. If the etching is to be repeated brush off the copper and apply the solution again. Whenever this etch is used it should be brushed over the surface whilst on, to ensure regular action. When the etching is completed rinse well with jet or

spray; brush off the copper and treat the plate with concentrated nitric acid to remove all copper, following quickly with plenty of water. The plate must be dried quickly and treated with the gum 8, 20% phosphoric acid 1, or Roderzone No. 3. After which it must be washed, dried, and rolled up for the machine.

In the cases of zinc and aluminium, this etching virtually destroys the plate for further use, more so with aluminium than zinc, as the latter is thicker and may be scraped down again.

Dampers and Damping.

In printing from plates the dampers and damping board must be re-covered with new clean material, as there must not be any trace of the solutions used for stone work left in them. The brass or zinc rider, recommended many years ago, should always be used on the dampers, as it collects any stray dirt from them. This rider must be occasionally cleaned.

The care required in printing from aluminium so far as the dampers are concerned is to see that when the plate is left on any occasion, however short may be the time, that no water can possibly dry slowly on the plate; and more especially, always remove the dampers far away from the plate whenever printing is stopped and there is likely to be either a short or long stoppage.

In printing from zinc or aluminium always commence with a surplus of water, and gradually reduce the quantity whilst the ink is being fed up to the proper quantity. On no account use sour gum on the plates.

Damping upon rotary machines is not as effective as it might be. The rollers become squeezed out of shape, and generally leave too much water for good printing.

The damping apparatus of the rotary must be kept scrupulously clean. An occasional wash up of the brass rollers with flannel soaked with dilute phosphoric acid and a little pumice powder is effective. The dampers themselves must be occasionally picked over to clear them of loose and dirty fibres.

Inking and Rollers.

The inking rollers for plates should be of fine nap, and for aluminium the first one or two rollers may advantageously be covered with india-rubber. The adjustments of the machine should be such that the rollers on commencing the inking,

should already be revolving at a proper speed to prevent skidding on to the plate, and forcing the plate to initiate their rotation. This is so well provided for in rotary machines that they are the best form of machine for plate printing. They, too, have the damping rollers so worked as to prevent any undue pressure or friction upon the plate.

Treatment with the ammonio-silico-fluoride mixture, or Roderzone, apparently makes it easier to print some metallic inks, such as vermilion, which are said to give trouble. But it is well known that since the use of phosphoric acid became general for zinc, there has been little or no trouble with such inks, providing they are well ground. In preparing an ink, the varnish should be so well ground into the pigment that each particle of pigment is encased within a film of varnish, and is effectually prevented from acting on the plate. There are, in fact, extremely few instances where any difficulty has arisen, and there is little doubt these were due to badly ground inks.

For aluminium the inks must be exceedingly well ground, and should not be used unless fulfilling this condition. In printing tints the ink should be worked as stiff as possible. Before printing from aluminium run a sheet through, with inkers and dampers raised from the plate. If the work appears faint on the plate, add a little fatty matter to the ink and it will strengthen it. Warm water should be used in winter for damping; in summer it must be kept cold.

In printing from metal plates in rotary machines the inkers must be carefully adjusted so as to just bear on the plate to ink the work, but no more. The number of inkers usually put on a rotary is rather excessive and may advantageously be reduced.

The pressure on rotaries should be adjusted to a fine nip, by springs if possible.

For printing bronze blue from plates, soften the ink with a little Venice turpentine, or balsam of Tolu or syrup of diachylon with varnish. The ink must not be mixed with too much strong varnish.

When bronze has been printed first it has an effect on the plates printed from afterwards. This must be carefully watched, and wherever possible a tint varnish should be run over it before proceeding.

Always keep the temperature of the printing room up to 70° F. in winter, especially for aluminium.

The use of rubber rollers in printing from plates may be carried to excess. If too numerous it frequently follows that they squeeze too much moisture off the plate, and cause difficulties in the damping operation. A proper number of rubber and leather rollers should be used, and although it is found that the two leading inkers may be rubber and the others leather, placing the rubber rollers as the second pair of inkers may prove effectual.

New leather roller skins, when used on rotaries, very soon become loose and must be tightened up.

The ink for rotaries should always be fairly stiff to start with as the speed of the machine in all its parts creates heat by friction, which thins the ink to some extent.

The use of magnesia or starch in tint inks is frequently effective in keeping them firm and preventing scumming.

The "German Lithographer's Year Book," 1907-8 states that the following mixture may be used instead of pure varnish :—Thin varnish from which the superfluous fat has been extracted has some magnesia ground into it. Then add sal ammoniac until the mass is ductile, add an equal quantity of sulphuric ether and paraffin ether, the amount of the two together being about one-fifth of the whole of the previous mixture. This mixture must be well ground and kept well protected from evaporation ready for use.

Damping Water and Scum.

For keeping the scum off zinc plates it is recommended that a strong solution of tea be used. A solution of golden syrup is also effective, and a very weak solution of bi-carbonate of soda may prove useful. If the plate has been treated with the Roderzone No. 1 solution as the final etch it is stated that the Roderzone No. 2 solution will prevent any scum. In that case pure water alone should be used for all damping purposes. In the case of aluminium it is also stated that if the plate has been treated with Roderzone No. 3 solution for the final etch, then the Roderzone No. 4 solution will be effectual in removing and preventing scum. In any case the use of a wooden stump or felt pad with a little pumice powder and the "Roderzone" will remove scum which will not yield to the solution alone. Of course great care must be exercised in using any abrading powder, as scratches are detrimental to good working. If

scratches do occur the plates should again be treated with "Roderzone," 1 or 3 respectively, or equivalent solutions as already described in previous chapters.

It is possible to minimize the trouble of scumming on plates by the addition of a little Canada Balsam to the printing ink. Other remedies for scumming are quoted in the details of recipes (see p. 95).

The cylinder blanket should be as firm as is consistent with good work. If it be too elastic or soft, it may give smeared impressions.

Chromo papers, when used on rotaries, give off a little of the coating at each impression, and, in course of time, the action of the coating particles on the work may prevent solidity of work.

Throughout these chapters turpentine has been mentioned without any suggestion as to the use of substitutes, such as have been upon the market under various names for some sixteen years. Each one has its own characteristics, and has been more or less successful in doing work previously done by turpentine only. The recent improvements in these substitutes have been considerable, and at the present time (1909) the new turpentine substitutes, Nos. 1 and 2, made by Messrs. Hughes, Treleaven & Co., of Liverpool, specially for use upon zinc and aluminium, fulfil satisfactorily all the general requirements of turpentine.

CHAPTER XIII.

Special Plates and Solutions.

Möller's Patent Plates.

1883. *Patent No. 2836.*

As so much of the present day treatment of zinc is so similar to the method of using the "Litho-Plate," introduced by Messrs. C. and E. Layton, (or "The Litho-Plate Co.") 56 Farringdon Street, London, it is interesting to quote extracts from the foolscap circular of January, 1887, as follows :—

Bed plates were made from demy to quad crown at £6 to £10 10s. each. (Patent 710. 1885.)

"Etch" or treatment of new work on plates :—

20% sol. of potassium bichromate in water	½ pint.
Weak gum solution	½ ,,

To be kept in a dark bottle (wine or stone), and only make sufficient for a fortnight, as it deteriorates.

The "etch" used as weak nitric acid is used on stone :—

Phosphoric acid (Sp. Gr. 1·5) ...	1
Water	1
Strong gum solution	30

Strengthened for use after scraping a plate by more phosphoric acid.

The cleaning solution to remove the work :—

Stick or strongest caustic soda ...	2½ ozs.
Clean (distilled) water	1 pint.

Original work on plates by crayon or ink. Use fresh ink rather stiffer than for stone. Work can be taken out with turps. or benzine. After rolling up scraping may be performed to lighten tints, or take out spots in stippling, so as to expose the zinc only, and following with the stronger phosphoric etch. Originals were treated ("etched") with the potassium bichromate mixture, sponged on thinly; allow to dry; wash out with turpentine only on the dry "gum"; roll up until solid, then

sprinkle with water and roll till sharp and clear; soak off any adherent "gum"; finally etch with phosphoric acid. Clean up with wooden (acid) stump, using the caustic soda solution mixed with turps. Rinse off quickly with clean water or gum sponge. Any scraping for reducing tints, or removing defects may be done at this stage, but only baring the zinc, and immediately apply the stronger phosphoric etch. Gum up, wash out and proceed to prove.

Finger marks on the plate should be removed with benzine before any other treatment.

Transferring may be done on dry or wet plate. Hot water must not be used on these plates.

The transfer paper is damped off, and the work treated exactly as for originals above.

Additions may be made by clearing the gum off, and cleaning the plate with citric acid, then washing with clean water. When dry make the addition.

Alterations are made by carefully clearing off the work with turps and water and a flannel. Follow with careful treatment with the caustic soda solution, and wash quickly with water. Dry; apply some etching; wash; apply weak citric acid; wash well; dry, and make alteration. After either addition or alteration, treat with the potassium bichromate and gum, and following treatment as for originals and transfers.

Storing the plates was done by gumming up thinly, drying, and wrapping in paper—not gumming the paper on. When required, wash off the gum with water and a thin film of the potassium bichromate and gum. When dry, wash out with turps. only and proceed as for originals and transfers.

In the machine all the usual safeguards were recommended. For long runs an occasional treatment with potassium bichromate and gum, allowing it to dry, proved effective. At the end of the day, the plate was rosined, etched and dried, then washed off and left under gum.

Engraving could be executed similarly to stone. Cover the plate with etching, dry and wash off with water. Lay a ground of red or black with gum. Engrave or sketch the design or drawing so as to bare the zinc and just cut the surface. Broad and fine lines to be engraved the same depth. Faults to be covered with "etch" coloured with red or black. When complete, fill in with linseed oil; remove surplus oil with dry cloth

(not a water damp cloth); roll up solid black; dab ink on any part appearing bare; finally, soak off the grounding and surplus ink and prove. Such plates could be printed in the machine or treated as copperplates.

Plates could be entirely re-cleaned by the same treatment as for preparation for alterations, provided the work had not been on a long time.

PENROSE'S "LITHO-ZINC" PLATES.

Specially contributed by MESSRS. PENROSE & CO.

The Penrose Litho Zinc Plates are manufactured under the patents of G. H. Block, who for upwards of thirty years has been engaged in developing metal plate lithography. As special or prepared zinc plates there is little doubt that these are practically amongst the best, even if they are not actually the best.

These plates are not simply sand-ground, but undergo a course of chemical treatment which imparts to them an eminently suitable surface for either direct drawing or transfer work. The grain can be either extremely fine for direct photo-printing, or in any degree of coarseness down to that required for bold chalk drawing for poster work. Their light tint makes them more acceptable to lithographic artists for direct drawing than plain zinc, and they are particularly advantageous for colour work. Transfers are made upon these plates in the same manner as on a litho stone (wet or dry). Mr. Block's method of treatment with potassium bichromate and gum is the substitute for the first etch, and after the solution has been spread evenly over the plate, leaving only a slight film, it is allowed to dry thoroughly. The work can then be washed out with turps. or with a special washing-out fluid. The plate is next sponged over with water, damped with a cloth and rolled up, when the work will appear clean, sharp and strong. This method can be equally applied to transfers or originals. An important advantage is that alterations and additions of new work can be made on these plates by means of a special re-preparing solution. The part which requires altering is removed with a mixture of equal parts of No. 4 solution and turpentine applied with a small piece of felt or flannel, and then rinsed well with water. A special re-preparing solution for restoring the

sensitiveness of the plate is applied with a camel hair brush to the parts where the work has been removed, and after the solution has remained for a few seconds it is rinsed off with water. This operation is repeated several times till the surface looks clean. There is little possibility of the old work coming up when the plate is re-prepared by this method. When old plates have to be re-prepared, it is recommended that they should be sent back to the makers, if users are within easy reach, but arrangements can be made to enable lithographers to re-prepare the plates themselves. Mr. Block has applied his methods with equal success to aluminium.

The special solutions to be used with these plates are :—

No. 1. Re-preparing solution, or re-sensitizing fluid, used as acetic and citric acids are, in lithography.

No. 2. Cleaning solution for erasing work, to take dirt or greasy spots out of the plate, much in the same way as caustic soda or potash is used on plain zinc.

No. 3. Bichromate of potash solution, to be poured on the plate with the moist gum and mixed together. It acts as the first etch for new work.

No. 4. Etching solution : used as all second or final etches are on zinc.

No. 5. Washing-out fluid or "doctor."

For clamping zinc or aluminium plates effectively on the usual style of iron bedplate, Messrs. Penrose & Co. supply a very simple and effective bending machine for turning over the edge, so that it can be clamped. They have, however, recently introduced a new form of bedplate, which does not necessitate the plate being bent over. This is particularly suitable for plates which have to be put into photographic printing frames, as it is difficult to flatten out the plates again, if they have to be re-prepared for further use.

LITHO-ZINC PLATE TREATMENT.

For originals and transfers gum up with fresh, strong, clean gum, and sprinkle solution of potassium bichromate on the plate, distributing and mixing them with a clean rag. Gradually remove the surplus of this mixture with the rag, until only a thin film remains to dry on the plate. After, say, five to ten minutes—not longer—wash out the work on the dry gum with

turpentine, and apply the washing-out fluid (No. 5) with a clean soft rag. No water must be used in this operation. Having allowed the "doctor" to dry, sprinkle with water, and with a slightly-charged black ink rag go over the work, clearing off the gum and surplus grease. Roll up well, fan dry, dust with talc, and apply the etching solution (No. 4). Using a sponge for this etching it may be applied to the plate several times, and by squeezing the sponge out the etch may be reduced to a mere film; fan dry quickly. The plate is ready then for proving.

For proving in colour gum up afresh with bichromate solution, dry, and wash out with turpentine and clean rag only. Then with turps. and colour rub up with a rag.

Whenever a plate is taken up for working—especially old plates—gum up with bichromate solution, dry and wash out as for originals. The bichromate treatment prevents scum on the plates. The plate may be kept clean in printing by occasionally using a few drops of tartaric acid ½ oz. and water 1 pint. Scum can generally be removed and prevented by good rubbing over with gum.

If desired, transfers may be treated as for stone, omitting the bichromate treatment. The etching is applied after rolling or rubbing up and dusting with talc. The etch is washed off and the plate gummed up. The gum must be left to dry, and the work washed out on the dry gum with clean flannel and turps.

In treating crayon drawings, commence with etching solution and gum solution in equal quantities and apply it with a fine camel hair brush. Remove the etch with clean water, gum up thinly and dry; proceed to wash out on the dry gum, roll up solid black; sprinkle with water and wipe off surplus gum and ink; roll up, dust and etch as before. Whenever a plate is to be washed out always gum thinly, dry, and wash out on the dry gum.

Off-sets may be put down on dry plates. If the special off-set powders containing aniline dye are used, the plate may be damped with either pure clean turpentine or benzine.

Alterations and additions may be made by rolling up well in black and dusting with talc. The work is removed by rubbing with felt stump or rag and solution of half turpentine and half etching. Rinse well with water and apply the re-preparing solution several times until the plate looks thoroughly clean. Dry off with white blotting paper and make the necessary

alteration or addition. Then treat with the bichromate solution as for originals.

Additions only may be made by rolling up well and dusting with talc. Prepare the plate with the re-preparing solution reduced to half strength with water. The solution should be rinsed off after a few seconds and applied two or three times similarly. Dry off with clean white blotting paper. Make the addition and proceed as for originals, with bichromate solution, &c.

Printing in the machine should be preceded by rolling up, dusting with talc and etching. The etch should be reduced to a thin film and dried. Wash off with water, gum up thinly and dry. If colour is to be printed wash out with turps. on the dry gum. Allow it to evaporate, then sprinkle with water and remove all the gum and black ink with a soft clean rag. Roll up in the required colour in the machine.

At night the plate should be rolled up in black and etched, and gummed up with half gum and half bichromate solution, a piece of brown paper being placed all over the plate to prevent the action of light. In the morning re-start the plate as already described above for commencing printing.

Spots of dirt may be removed with a wooden stump and half etch and half turpentine. If this be not strong enough use some of solution No. 2 with a little gum, and follow with the etch.

In printing, the damping water may be half cold tea, or a few drops of the etch may be added to the pailful of water. A little vinegar and a little gum may be added for the same purpose.

In printing use approximately half thin and half middle varnish for the inks. Avoid grease in every way, and an occasional treatment with bichromate solution is very beneficial.

Scumming frequently arises from using the ink too thin. Gently rubbing with strong gum and soft felt should remove it; rolling up and etching occasionally is of advantage. If charcoal or polishing stone be used, or if scraping be resorted to, the place should be treated with re-preparing solution and finally etched.

The ink for drawing on these plates should be half Lemercier and half Vanhymbeeck's inks. It should be freshly made and not too thin.

"Litho Zinc" plates are sold by Messrs. Penrose & Co., 109 Farringdon Road, London, E.C.

PARKER PRINTING PLATES.

The Parker Plates are the subject of a secret process and the special feature which is claimed for them is that they do not oxidize. They were introduced to the trade in 1906.

In the use of this plate, as in many of its predecessors, there are several proprietary solutions, each bearing its special number. These solutions are :—

Nos. 1 and 2. 1 oz. of each to 16 ozs. thin gum solution, to make the etch.

No. 3. Washing-out fluid or "doctor," to be thinned with turps.

No. 4. Damping water solution. Add "half a cupful" of No. 4 and "one cupful" of gum solution to "one pailful" of water.

No. 5. Cleaning solution for removing old work.

No. 6. Etch for re-sensitizing a cleaned plate. One part No. 6 to 15 parts water.

The general procedure is very similar to other zinc plate methods, only substituting the numbered solutions for those already in use.

Original work in ink or crayon is etched with etching solution, reduced to half strength (No. 1, 1 oz. ; No. 2, 1 oz. ; gum arabic solution, 32 ozs.), applied with a soft brush and washed off immediately with gum solution. Then go over the plate with a damp soft cloth to smooth the gum ; fan dry ; wash out on the dry gum with the "doctor," No. 3 solution thinned with turpentine ; again smooth the surface and fan dry. The work is then ready for rubbing, or rolling up and proving. If some of the work requires strengthening, or new work is to be added, roll up well in good stiff ink, thoroughly clean the plate with water, dust the work well with talc (French chalk), and proceed to sensitize or clean the parts where work has to be added with No. 6 solution 1 to water 15. Allow this to remain on the plate five minutes ; wash well with clean water, fan dry, and add the work with ink or crayon. Treat the new work the same as an original, i.e., with etch and "doctor," before rolling up. If the work has already been etched and rolled up, and alterations are to be made, proceed to wash the gum off well, after rolling up, and dust with talc. Treat the parts to be altered with benzine to remove the ink and varnish. Apply solution No. 5 to eradicate the grease,

using a piece of felt and a little sand. No. 5 solution is strong and should not touch the hands. After this treatment a little stain may remain which is of no consequence. Wash well with water, fan dry, and rub lightly with fine sand; brush off the dust; make the alterations and treat with etch and "doctor" as for originals before rolling up.

For transferring use good sharp black impressions and put down to dry or damp plate with a good pressure. Damp the paper off, gum up, and as it is drying rub up with ink. Smooth the gum, fan dry, dust with talc, and apply the etch, half-strength. Gum up thinly and smooth the surface; fan dry and wash out with the "doctor," No. 3 solution; smooth the plate and fan dry; wash off with clean water, dust with rosin and talc; clean the plate with wooden stump and pumice powder and finally etch, full strength. Gum up, fan dry, and proceed to prove or print. Additions and alterations are made as already described.

To preserve the plates, gum up, smooth the surface, fan dry, wash out with "doctor," fan dry, and wash off with clean water. Gum up thinly, smooth the surface, fan dry, and put away without ink.

In machine work use short (buttery) inks. Use as little water as possible, and, if using thin greasy inks, use No. 4. solution to avoid scumming.

In using these plates avoid sponges which have any trace of nitric in them. Never use sour gum, and keep the plates in a dry place.

The Parker Plates are sold by Messrs. F. Horsell & Co., Victoria Road, Leeds.

"ECLIPSE" LITHO ZINC PLATES.

The latest zinc plate upon the market is that which is grained and prepared on Morris & Bolton's premises in Took's Court, London, E.C. No patent has been applied for, so the preparation is known only to those who apply it. This plate has been well tested by large firms in England and Scotland, including London houses, and the results are as good as anything hitherto obtained.

The whole treatment being an exclusive one, it is accompanied by the various solutions specially prepared for application.

They are :—

Etching solution.
Washing-out solution.
Sensitizing solution.
Cleaning solution.

A washing-out solution may be made by dissolving 2 ozs. "Lithine" in 1 pint of warm turpentine.

A cleaning solution may be prepared by dissolving 1 lb. caustic soda in 8 lbs. of water (6½ pints).

The method of using these plates is, so far as the draughtsman is concerned, the same as for stone. It may be noted that they are very light in colour, somewhat resembling aluminium.

The treatment of originals in the press. Apply with a soft brush an etch made of etching solution 1 part, thin gum 6 parts. When etched, lay a sheet of paper on and rub it down to remove the gum. Repeat until no more gum can be drawn off. Fan dry, and on top of the dry gum wash out with the washing-out solution, thinned if necessary with turpentine. Wipe the plate over evenly and fan dry. Wash off with gummy water, roll up, dust with rosin, then etch with etching solution 1 part, water 1 part.

To make additions. Roll up sparely with ink and dust with rosin. Wash with clean water. Apply a mixture of sensitizing solution 1 part, water 1 part, and allow it to lie on the plate two minutes. Apply it a second time. Wash well with clean water, dry, make the additions, and treat as for originals.

To make alterations. Wash out with benzine, apply the cleaning solution and some pumice powder; rub gently with a piece of felt, or felt stump, rubbing in circles—not straight. Wash well with water, apply sensitizing solution as above for additions; wash well with water and fan dry. Make the alterations and treat as for originals.

Transferring. Pull transfers clean, sharp and moderately full—not grey. It is recommended that transfer ink should be made of "Eclipse" transfer ink 3 parts, good black ink 1 part. Wash plate well with clean water using a clean linen cloth kept for the purpose. Wipe the water off until a mere film remains, sufficient to ensure the transfer sticking at the first pull through. Transfer under heavy pressure. Wash off with a perfectly clean sponge kept for the purpose. The plates are very sensitive, and will take grease from a dirty sponge. When the

transfer paper and composition are removed, wash with plenty of water, fan dry and do any necessary repairs. Gum up, and proceed to rub up the work, using gum sponge as it proceeds. Wipe off the inky gum, fan dry, dust with rosin and etch with etching solution 1 part, water 2 parts. Wash off and fan dry. Then gum up the plate as when treating an original after the first etch. Draw off the gum on sheets of paper, fan dry, wash out on the dry gum with the washing-out solution and turps if necessary. Smooth out on the plate and fan dry. Wash off with gummy water. Roll up and dust with rosin. Clean the plate, using a fine wooden stick with pumice powder and the cleaning solution. Rub the dirt off with a rotary motion of the stump, and avoid letting the cleaning solution touch the work. Etch with etching solution 1 part, and water 1 part. Gum up, wash off the gum, roll up with roller sparely charged with ink, and proceed to prove.

Printing in the machine. Commence with plenty of water. Use stiffer inks than is generally done with stone. Tints should be made with tint medium and varnish, and should have the consistency of body colours. Avoid the use of fats and fatty "doctors." If from any cause there should be scumming, wash over with a mixture of etching solution 1 part, water 25 parts. Touching up lines on the plate may be done with a 6H lead pencil. The tests for long runs, all of which have been carried out successfully, prove that not only does the work go down strong, but that it retains its sharpness at least up to 80,000, possibly more.

ALGRAPHY PLATES.

The plates of aluminium supplied by Algraphy, Ltd., Sternhall Works, Macdermott Road, Peckham, London, S.E., for aluminography are grained in three grades—matt, medium and coarse—and these seem to meet all the requirements of the trade.

The procedure with these plates is generally as already described in the previous chapters. New plates after lying in stock should always be freshened by treating with sulphuric acid 1 part, and water 10 parts.

A plate to be re-prepared has the work removed, either by turpentine, benzine, carbolic acid, or a suitable combination of these. The plate should then be washed and immersed in the

nitric acid bath (nitric acid 1, water 3). The nitric acid must be free from hydrochloric acid. Leave the plate in the bath ten to twelve hours; remove and rinse it; then grain by hand or machine.

For rapid re-preparation, remove work with turpentine and pour on some of the plate-cleaning fluid "D," assisting its action by rubbing with a piece of felt, until the work has quite disappeared and the plate assumes a bright colour. Wash well and re-grain.

The treatment for originals is to dust well with talc, and sponge all over quickly both ways of the plate, with the "A1" etching solution. Squeeze the sponge as dry as possible and again go over the plate to remove the surplus etch; finally, gum up and fan dry. Wash out on the dry gum with the washing-out fluid or "doctor" "B." Allow it to evaporate then wash off the gum and roll up, using a fine soft rag for damping.

Rubber rollers are recommended instead of leather. After rolling up well dust with talc and give the plate a good etch with solution "A1." Wash off, gum up, fan dry and proceed to prove.

For alterations, roll up well and dust with talc; remove the work with sulphuric acid containing a little gum; after three or four minutes' action wash off quickly with water; dry the plate and apply the re-sensitizing solution "C1," allowing it to act for five minutes, then wash off with clean water; dry the plate, make the necessary new drawing or transferring, dust with talc, etch, &c., as described, and proceed to prove.

For off-sets a powder may be used consisting of 1 lb. red raddle (raddle is a red earth coloured by sesquioxide of iron) and 1 oz. violet aniline powder in equal quantities, mixed in water; dry by heat and pulverize to powder in a mortar. The plate may be damped slightly and the off-set run down.

For transferring use Berlin or French transfer papers. When using French paper damp the plate slightly with alum-water (alum 1 tablespoonful, water 1 pint). Always clean the plate on front and back. Use about eight sheets of soft pliable backing; run through a large number of times (15 to 20); remove the paper with warm water, leaving the composition. At this stage work may be added to or removed from the plate; gum up, fan dry, and wash out with the "doctor" fluid "B"; fan dry; wash off with tepid water and roll up; dust with talc

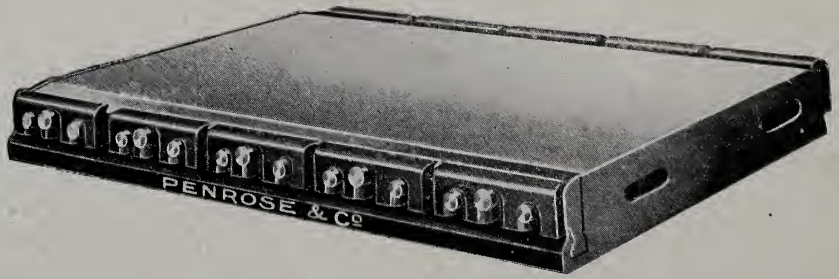
and etch with the transfer etch ; gum up ; fan dry, and proceed to prove or print. It is advisable to allow plates to stand an hour or two before printing.

The dirt or spots on the plate may be removed with a stick of charcoal, or soft india-rubber. A wooden stump with the etch may also be used.

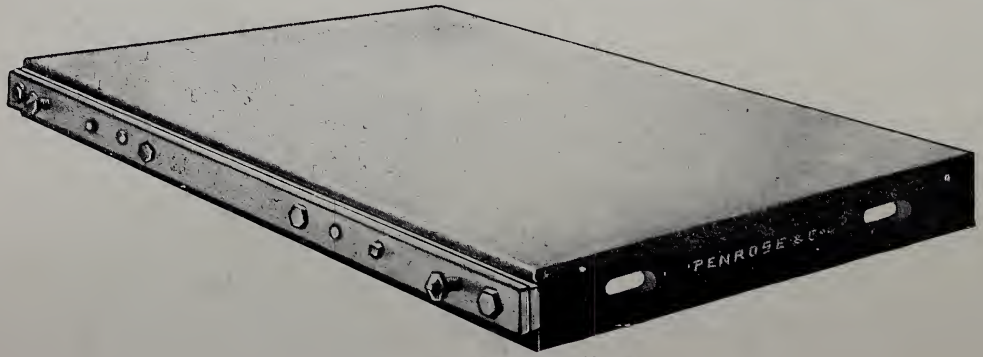
The method of fixing the plate on the bedplate is as follows :— Screw the extension bar close to the bed ; place the edge of the plate, with its doubled edge outwards, in the grippers at the opposite side to the extension bar, fasten up the grippers and proceed to bend the plate down on the flat bed. Place a sheet of clean paper on the face of the plate, then a flat piece of wood near the gripped edge, and with a mallet gently and evenly hammer the plate down to the proper bend. Release the grippers and insert the other edge to be bent similarly. Then the plate can be placed in both sets of grippers and expanded over the bed.

The machine rollers may be nap leather or rubber, but not glazed. Solid rubber on the stock is preferable to rubber tube

MULTI CLAMP BEDPLATE OF MESSRS. HORSELL & CO. 1908.



MULTI CLAMP BEDPLATE. NEW TYPE, 1908.



SINGLE CLAMP BEDPLATE. 1885-1909.

drawn over packing. But if the packing is quite even, as when Horsell's Seamless Packing is used, rubber rollers made upon packing are quite satisfactory. Rubber rollers must be washed with petroleum, wiped and dusted with talc or magnesia.

The graining of aluminium plates, when produced in the machine, should be regulated to obtain the grain desired by the length of time occupied, size of balls, and size and nature of "sand," as follows :—

Matt surface for transfers and drawing on : 50 minutes graining with balls of maple or lignum vitæ, about $\frac{7}{8}$ ins. diameter, and pumice powder through an 80 sieve.

Grain for copperplate transfers : 30 minutes with glass balls about $\frac{5}{8}$ in. diameter, and pumice powder through 80 sieve.

Grain for machine plates for commercial work and solid colours : 30 minutes with glass balls about $\frac{5}{8}$ in. diameter, and pumice powder or silver sand through 60 sieve.

Grain for fine chalk work and long runs of commercial work : 30 minutes with glass balls of $\frac{5}{8}$ in. diameter and 80 sieve sand.

Grain for medium chalk work : the same, but use 60 sieve sand.

Grain for poster work : 25 minutes with glass or porcelain balls of 1 in. diameter, with granite sand, crushed shingle or crushed flint through 30 sieve.

Grain for photographic work should be done by hand with a felt pad and pumice powder through 160 sieve.

From time to time the balls should be thoroughly examined, all those with flaws or flattened surfaces being removed.

The process was introduced by the Algraphy Syndicate in 1897 and was taken over by Algraphy, Ltd., in October, 1898, the capital of the Company being raised by public allotment for the purpose of acquiring the patent rights for the United Kingdom and Colonies. The process met with an immediate success, the largest printers installing the plates for flat-bed printing. Its general adoption was, however, greatly hindered by the high price of the metal, aluminium at that time standing as one of the most expensive metals; further, the Company insisted upon a royalty being charged and agreement signed

before the process was installed in any printing works. Despite these restrictions a ready sale for the plates was found, and when the graining machine and rotary were introduced by the Aluminium Plate & Press Company of New Jersey, U.S.A., the demand for the plates was such that the metal could not be produced in sufficiently large quantities to fill the orders, and supplies had to be obtained from Germany and America.

The patent rights of the Company having now expired, printers are at liberty to use all the formulæ previously belonging to the Company. The method of treating aluminium as advised by "Algraphy" has been very largely adopted. The price of the plates, their durability and other features, have ensured their extensive adoption for rotary machines.

The Company also makes the "Optimus" zinc plates. The metal used is commercially pure, and the fine mechanical grain serves as a good water-retaining surface. The treatment of these plates is the same as for plain zinc.

THE STRECKER PROCESS.

The Strecker Process, which has been adopted in many houses, consists essentially of treating the plate with a solution after it has been rolled up and etched, which forms upon the plate a glaze or coating having the power to hold moisture and repel ink. In the Patent Specifications, especially No. 2234, *1902,* some weight is put upon the possible electrolysis which occurs when certain chemicals are brought in contact with zinc (and aluminium). Concerning that, however, it is not necessary to enter into any discussion, but the solutions used call for some reference. In describing the effect of certain re-agents, it is stated that some of them may only result in a decomposition of the salt used, or the deposition of a caustic layer unfit for printing purposes. It is stated that using silicofluoride of ammonia results in a decomposition into hydrofluoric acid, silicic acid and ammonia. In a small treatise by Blecher (*see below*), Dr. Otto C. Strecker recommended the use of equal parts of ammonium silico-fluoride and ammonium nitrate with water and gum, which upon experiment on zinc, using little or no gum, gives a satisfactory result, and in the Specification (1902) is shown how this combination results in the formation of zinc fluoride, ammonium silicate, ammonium nitrate and water. The treatment described, proceeds,

In preparing the plate it is treated with :—

Acid fluoride of ammonia	5 ozs.
Ammonia	3 ,,
Water	1 gal.

This removes grease and impurities. The plate is well washed, dried and grained, and finally washed with nitric acid—50 drops in 1 pint of water. When washed and dried the drawing or transfer is put on ; followed by gumming up, drying, washing out with a "doctor." Then wash off and roll up the work ; dust with rosin, finishing with soft pad and talc. Then treat with :—

Ammonium acid phosphate	22
Ammonium nitrate	20
Gum solution	200
Water	1000

The solution is applied with a brush and allowed to act for two or three minutes, thus producing the required layer on the zinc or other metal, which will retain moisture and repel ink. The plate is then ready for rolling up and printing. This constitutes the Strecker Process.

The second etch, whether it be the ammonium silico-fluoride or ammonium acid phosphate has, it is understood, been purchased by C. G. Röder, Ltd., the music printers, having works in Leipzig and at Willesden Junction, London, N.W. The solutions are now made up under the name of "Roderzone." They are variously prepared to suit the second etching and use in the machine, for both zinc and aluminium.

The small treatise by Blecher, entitled "The Treatment of Zinc for Lithographic Printing, by the Special Process of Dr. Strecker" ("Die Verwendung des Zinks für den Lithographischen Druck, nach dem Verfahren von Dr. Strecker"), published by W. Knapp, Halle, was reviewed in the *Process Engravers' Monthly,* January, 1907. In the brief translation given the most important part is the recommendation of Dr. Strecker to use either of the following mixtures for the final etch :—

1. Ammonium silico-fluoride 1
   Ammonium nitrate 1
   Gum water, sufficient to dissolve.

   This may be allowed to act
   for about two minutes.

or

2. Ammonium bi-phosphate 1
Ammonium nitrate 1
With sufficient gum water.

In actual experiment, however, less gum and more water prove more effectual.

In the same treatise the graining agents recommended are :— Emery 000 to 0, finest pumice, yellow sand, flint sand and grit, which will sift through 120, 70 and 50 sieves for the various grains. The graining balls should be 20 mm. ($\frac{7}{10}$ ins.) diameter, 25 mm. ($\frac{4}{5}$ in.) and 30 mm. (1 in.) for fine, medium and coarse grain. The graining balls may be ordinary flint pebbles, spheres of glass, porcelain or wood, or potato-shaped porcelain pebbles. The graining with finest pumice and emery 000 should occupy 40 minutes and all others 20 minutes. It may be added that the use of emery at all is very doubtful; it has a strong tendency to scratch.

The Strecker Process has been fully dealt with in all its bearings in the treatise by E. Eberle and J. Goodman, entitled "Metalithography." This work, however, includes some of the details already quoted in the previous chapters of this treatise; whilst the actual use of the "Roderzone" fluids may be summed up as above, with the supplementary matter culled from the Specifications of Patents, numbers 6701, *1900,* and 2234, *1902.*

In dealing with the uses of "Roderzone," the above authority states that it may be used with a wooden stump, as acid is used, but with the addition of some rouge or pumice powder, for cleaning off spots of grease.

In treating a zinc plate for the production of transpositions, it is recommended to cover the plate with a film of "Roderzone."

For the process of etching half-tone or line blocks the "Roderzone" solution is recommended for the first treatment after the work has been inked up.

It might be here added that W. Dickes in his patent, 16884, *1884,* claimed the use of solution of "silicate or other substance" which would give to the plate a kindred property to litho stone to absorb water, and in principle forestalled the Strecker Process by some eighteen years.

Again, in 1892 H. Bittner, in his patent 12688, carried out apparently the methods of Dr. Strecker as indicated in his 1900

patent by electrical deposition, and in his patent of 1902 by mere chemical change during contact with the zinc. Bittner preferred an alloy of $\frac{2}{5}$ tin with $\frac{3}{5}$ zinc, although he claimed that it would affect any metal. He prepared the plate by immersing it in a bath of silicate suspended in an emulsion of gum arabic and water. From this bath it was taken and immersed in another bath of nitrate of lime and water. In treating the metal by this process an insoluble compound of the zinc was formed by the silicate bath, and followed immediately by the nitrate bath which oxidized the hydrogen evolved in the silicate application, thus producing a salt on the zinc of a hygroscopic character, like lithographic stone, and consequently repellent of grease when damp. The plate was afterwards treated with lime water containing a little sulphuric and hydrochloric acids. This latter application could have done little, for the slaked lime would be converted into the chloride of calcium and sulphate of calcium, both of which would have little or no effect upon the salts already deposited, more especially as after the final treatment the plate was well washed and dried.

DR. STRECKER'S METAL PRINTING PROCESS.

Specially contributed by C. G. RÖDER, LTD.

Dr. Strecker, who is one of the authorities on chemistry as applied to printing, has for some years, in common with others, advocated the use of zinc instead of aluminium, and he has perfected a method the success of which seems to justify the claim that zinc is a better medium for printing purposes than aluminium. The process has for the last three or four years been popular on the Continent and in America, and since the beginning of 1908, when C. G. Röder, Ltd., the music printers of Willesden Junction introduced it to this country, it has also made progress in London, the Midlands and other printing centres, and some of the best lithographic printers use it now on an ever-increasing scale. It has been said that the process may, within a few years, replace the present aluminium methods. This may be somewhat exaggerated in view of the well-known conservatism of our craft, but it is certain, considering the success of the process and having regard to the results obtained by its use, that every printer who

looks into the future must seriously reckon with Dr. Strecker's Process.

The great principle involved in the application of this new method is to produce and maintain a perfect water-retaining layer on the uninked parts of the plate surrounding the design to be printed. Senefelder himself is known to have made experiments with metal plates, zinc especially; he was perfectly aware that metals have an affinity for fat, but he evidently did not succeed in producing a satisfactory water-retaining surface. Many attempts to utilise metal plates have since been made, but it is safe to say that the invention of Dr. Strecker is the first real solution of a difficult problem. By this method an insoluble layer is produced on the portion of the plate not covered by the design, which is strongly water-attracting and so completely ink-repelling that runs of 100,000 and more can be worked off the transfer with ease, the last print being as sharp, clear and clean as the first. This layer is produced as the result of an electro-chemical process, by means of which the "Roderzone" (this being the name under which the etching preparations are sold) forms with the metal of the plate fresh substances which are part soluble and part insoluble. The soluble substances are washed off and the insoluble form the hygroscopic layer. The latter is perfectly insoluble in water and weak gum compound acids, but it can be easily removed by treatment with nitric acid which restores the surface to its former condition and renders it highly sensitive to fat. An important feature of "Roderzone" is that it never corrodes the plate even if frequently used on the same part. Some of the other methods require the use of acids which corrode the plate, and if used repeatedly to overcome scum, tinting, &c., undercut the fine lines and make the work "rotten" or cause it to disappear altogether. "Roderzone" produces a definite oxide compound with the metal, and therefore further oxidation is impossible. This is another important advantage of the process, as the subsequent oxidation in other processes is often the cause of trouble and especially in connection with aluminium. In spite of the many advantages which zinc offers in comparison with aluminium, the price of the plates is a little cheaper, the cost of zinc being rather less than the cost of best aluminium plates. Zinc plates are of course sold in the market at prices which vary considerably, and it is well to remember

that for the Strecker Process no expensive "prepared" plates need be purchased, as ordinary good unprepared zinc can be used. It is not necessary to return the plates to the makers for re-preparation as they can be quickly and cheaply re-prepared by any printer's labourer, providing that he understands graining plates. In addition to the advantages enumerated above, and which apply more or less exclusively to the Strecker method, there are, of course, other advantages which are the common feature of all metal printing methods in comparison with stone. There is no risk of breakage which, especially in the case of the big stones, is a serious item in many shops. No trouble from veins, chalk patches and silica spots can occur when metal plates are used. A considerable saving is effected by reason of the easy handling of the plates, since even a 60 by 40 in. plate can be handled by a boy, whereas a stone of the same size requires several men to lift. Already, many firms who print from stone in their machines, employ metal plates for storing originals, on account of the great saving in space effected thereby. Transferring and making ready on the machine can be accomplished in less time and with greater ease; the pressure once obtained and set with the machine carriage, remains virtually constant when metal plates are used. The life of the zinc plate is fully equal to that of the lithographic stone, notwithstanding the infinitely smaller cost of the metal, and it is not surprising to learn that plates treated by the Strecker method last much longer than those etched with acids, as they are not continually exposed to the corrosive action of the acids.

The methods of working the process are, briefly, as follows:— When the plates have been bought in their natural state they are first treated with nitric acid to remove the hard scaly skin which appears on such plates. Then the plate is put into the graining machine or is grained by hand, the graining material being chosen according to the grain required, fine or coarse pumice-powder, sand, &c. After graining, the plate is treated with a weak solution of nitric acid and alum, and is then ready to receive either the original drawing or the transfer. The method of drawing upon zinc is practically the same as upon stone. Transfers are also fixed on the plate in the usual manner, the plate being afterwards gummed and the transfer washed out, for which operation the special washing-out

solution "Phirmold" is recommended. The plate is then inked with strong black ink until the negative is well covered and clearly defined; the "Roderzone" solution is then applied and allowed to act upon the plate for three or four minutes, and when its action is complete a hygroscopic layer will be adhering firmly to the plate. The plate, having been well washed, is dried and gummed and is ready for printing from. Plates prepared by the Strecker Process may be used either on flat-bed or on rotary machines with the same inks as when printing from stone. The rollers should be all leather, rubber rollers are not so suitable. It is well to use a sufficiently large quantity of water at the start, but the water may be gradually lessened and the ink increased. To use plates again for transferring after they have been printed in the machine, they are washed with caustic soda solution, then put into the grainer and treated like new plates as previously described. Plates treated in this way show little wear after being used hundreds of times.

Dr. Strecker recommends zinc plates for their cheapness and their general suitability, but as the principles of his invention also apply to other metals, especially aluminium, and as many printers hold a large stock of aluminium plates, and have long been accustomed to this metal, special etching preparations suitable for aluminium have been prepared and are being sold by the same firm. The usefulness of aluminium is greatly increased when used in connection with Dr. Strecker's Process, which offers distinct advantages over the aluminium processes now in use. The great drawback of aluminium plates, viz., their liability to oxidation, is completely overcome by the use of the Strecker method, for, as before explained in connection with zinc, the "Roderzone" produces an oxide compound with the metal and, therefore, further oxidation is impossible.

Dr. Strecker's Process of metal printing is patented, and C. G. Röder, Ltd., are the proprietors of the British rights. It is unnecessary to acquire a license in order to be able to work the process, as permission to employ the method is granted to all who purchase the "Roderzone" preparations from the firm direct or through its agents.

THE TUTZSCHKE PROCESS.

In November, 1907, Mr. J. F. Tutzschke filed a provisional specification for a treatment of zinc, after the work had been rolled up, such treatment standing in the same position in respect to its stage of use, as the Strecker Process. It is said to so act upon the plate as to render it more hygroscopic, and therefore better able to absorb water and to repel ink during the printing than the ordinary practice. The patent 25710, *1907,* was apparently delayed by some opposition, and it was only in November, 1908, that it was finally accepted.

The solution used is set out as :—

Potassium phosphate	2 ozs.
,, nitrate	2 ,,
Sodium phosphate	1 oz.
,, nitrate	1 ,,
Water	1 gall.

Inspection of such a mixture, with the knowledge that potassium and sodium compounds vary so very little in their action, make it appear almost unnecessary to use the sodium compounds at all, but simply add 1 oz. more to the potassium compounds for the 1 gallon of water used.

Practical experience has proved the efficacy of this treatment in a large music printing house in London.

The method of treating the clean-grained plate with weak alum solution prior to transferring is in accordance with modern practice.

The etch, as set forth, is without gum, and Tutzschke claims that this omission is far better than all preceding etches containing gum. It would appear, however, that as one special etch mentions the value of the arabic acid of gum, that Tutzschke has dealt with the matter as if gum arabic solution were always sour (acid). It should be pointed out that for the last twenty-five years every effort has been made to induce printers to always add a little whitening and a little carbolic acid to gum solution to prevent souring. This has been done to such an extent that it is improbable there is much sour gum used in the business. The omission of gum from the etch is by no means new, as the method of etching grained stones with nitric acid and water was common before 1840, and there is very little doubt that it would be practised on zinc, by the same firm at least, as early as 1845.

THE "SOLUS" SOLUTION.

For Aluminium, Zinc, and other Metal Plates.

Specially contributed by HUNTERS LTD.

This is a simple solution for which the makers claim that anyone unacquainted with the use of plates for printing purposes can, with its aid, obtain satisfactory results, as it enables the plate to be treated—in transferring, rolling up and etching—in precisely the same way as stone.

The Solution combines the properties of the several solutions already in use, although it is of an entirely different character. New plates are prepared with "Solus"; the work is etched with "Solus"; alterations and corrections are made with "Solus"; old plates are prepared for new work with "Solus." The directions for use as recommended are as follows:—

To Clean a Plate. When a plate which has work on it is required for a new design, the old work should be washed out with turps. or petroleum and pumice powder. After thoroughly washing out, the dirt, scum, &c., must be wiped off thoroughly with a piece of rag, taking care that no water is allowed to touch the plate. The plate is now sprinkled with pumice powder, and sufficient "Solus" Solution is poured on to keep the powder well moistened (no water being used). Well scour the plate with a piece of felt (giving a circular motion) for about five or ten minutes according to the size of the plate, adding "Solus" and pumice powder as required. When the plate is considered sufficiently scoured the powder, dirt, &c., must be washed off with clean water. The plate is now washed over with "Solus" only, using a piece of clean sponge kept for the purpose, and, after allowing the solution to remain on the plate for about one minute, it is washed off with clean water and the plate dried in the usual way. The plate is now ready to receive any drawing or transfer.

Transferring or Drawing. After the work has been transferred or drawn, the plate must be gummed up and fanned quite dry. The safe way is to gum. Wash out with asphalt solution on the top of the dry gum, using a piece of rag free from moisture. When the work is washed out the gum is washed off, and the work is now ready to be rubbed up or rolled

up direct, as required, but if rubbing up is considered necessary, care must be taken to see that the rag is free from grit and not too harsh, otherwise the surface may get scratched or greasy, and would, in all probability, spoil the work. From this point the work may be treated exactly the same as a stone. Whichever method is adopted, the work, after being properly inked in, is etched with "Solus" Solution, without the addition of any other substance, gummed in, and is then ready for printing. If desired the work can be etched any number of times that experience and discretion may dictate, but it should always be remembered that after each etching the plate must be gummed in and fanned dry before rolling up again.

Corrections. If a small part of the work is required to be altered it is best to rub it out first with slate pencil and water, and after drying the part "Solus" Solution must be applied and allowed to remain on for from one to two minutes. It is then washed off with clean water, the plate dried, and the plate is then ready for the correction to be made. If a large portion of the work is to be altered it should be rubbed off with "Solus" and pumice powder, following the directions already given for cleaning a plate.

This solution is sold by Hunters Ltd., Poppin's Court, London, E.C.

OTHER PLATES.

Although only the "Litho Zinc," "Algraphy Plates" "Parker's Plates" and "Eclipse" Plates have been dealt with fully, it may be added that most lithographic supply houses deal in other patent plates, as well as pure plain zinc. The latter is so largely used that it probably takes the premier position in printing from metals. The simplicity of its treatment, as described in previous chapters, is so evident that it is unnecessary for any printer to use anything else. In using plain zinc the printer is not confused by having to use a number of "mysterious" solutions with index numbers, and providing the general chemical principles are understood, a printer can vary the recipes given in this treatise as occasion requires. It may be further stated, without fear of contradiction, that when the use of zinc is thoroughly mastered there are few printers who would use aluminium. Aluminium is certainly a fine metal, but its manipulation is more complicated, and it may be said more

difficult than zinc, whilst the prints produced are only equal to those produced from zinc when properly handled. Aluminium plates of first-class quality are now very little more expensive than zinc. They can be obtained from almost any supply house. The best plates, however, are prepared by the firms making a specialty of them, such as Algraphy Ltd., The Improved Plate Co., 810 High Road, Tottenham, London, and Penrose & Co., Ltd.

The same firms, seeing the great demand for zinc, have added facilities for zinc plate preparation to their equipment, and can be relied upon to supply plates of a high quality.

One, at least, of these houses guarantees to supply plates without pinholes, buckles or other blemishes. The plates are submitted to very hard rolling, which no doubt lengthens the life of a plate for any class of work. The same firm claims that the grain produced all over the plate is even. A reference to the microscopic productions from grained plates in a previous chapter will show that as a rule the grain is anything but even, and may account for much of the broken work with which the printer has to contend.

PRICES OF ALUMINIUM AND ZINC PLATES.

The following records show how the cost of plates has varied in the last ten years.

ALUMINIUM.

RETAIL COST IN THE YEARS QUOTED.

Size of Plate.	1898.	1900.	1901.	1903-4	1906.	1909.
		£ s. d.				
10″ × 12″		0 2 1	1/4 to 1/10	1/6	1/-	1/-
14″ × 18″		0 4 4	2/9 to 4/1	3/9	2/3	2/- to 2/6
20″ × 26″		0 8 9	6/- to 8/2	8/2	7/6	5/9 to 6/-
22″ × 32″		0 13 9	7/6 to 11/3	11/3	9/-	8/- to 8/6
32″ × 42″	2/4		25/- to 35/-	35/-	18/10	16/-
40″ × 54″	per	1 17 6				
42″ × 62″	square		83/- to 112/6	63/-	46/-	37/-
44″ × 62″	foot.					37/6
46″ × 62″			90/-			
48½″ × 65″				75/-		
51″ × 64″					49/3	50/- to 65/-
51″ × 65″				80/-		

ZINC.

Retail Cost in the Years Quoted.

Size of Plate.	1900.	1901.	1908.	1909.	1909. Parker Plates
10″ × 12″	1/2	1/-	9d.	6d. to 9d.	9d.
15″ × 18″	3/10	3/4	2/-	1/5 to 2/-	
19″ × 24″		5'9		4/-	
20″ × 26″	9/10		6/-	2/10	
24″ × 32″				3/9	5/-
25″ × 32″	11/11	10/-	7/6	7/6	
32″ × 42″	19'7	17/-	11/6	6/8 to 11/6	
34″ × 42″					9/6
44″ × 62″				13/-	18/2
46″ × 62″	41'9	35/-	22/6	22/6	
48″ × 64″			25/-	15/- to 22/-	20/6

CHAPTER XIV.

Metals for Direct Transfers.

THE character of both aluminium and zinc render them peculiarly well adapted for receiving direct transfers, without the intervention of a paper transfer.

There are times when good negatives must not be tampered with, but they are not reversed for printing purposes. Such a negative may be used to obtain a fine grained collotype printing plate, which would, however, give reversed or incorrect prints. In this case, by using a thin sheet of aluminium, finely grained, a direct transfer may be taken from the collotype surface as set forth in Patent 4,345, *1904*, from which good transfers or prints may be obtained in the correct position.

In the use of tinplate printing machines, either for actual tinplate printing, or for lithography upon rough and common boards or paper, or in the use of the Off-set Rotary machine, it is necessary to have the design correctly disposed right and left on the plate on the printing cylinder. In this case any drawing or work on stone or plate, which is in the customary reversed position, may be transferred direct upon thin zinc or aluminium, either as the printing plate or as a source for obtaining transfers. In each case treat the transfer according to its correct manipulation.

USE OF METALS FOR HALF-TONE WORK.

Finely-grained aluminium and zinc are more suitable for half-tone transfers than litho stone. The difficulties arise in obtaining clean, sharp transfers from the block, and in the correct transfer paper to use. It is stated by Herr B. Enders, that the best transfer papers are the Berlin ; and there are special papers sold by Gilby & Hermann. In pulling the transfer, roll the block thinly, lay the transfer paper carefully, use a soft overlay and a thin glazed overlay ; pull through smartly without interruption. The transfer ink should be made of chalk ink 4 parts,

transfer fat (stearin or wax) 1 part, and a little thin varnish. When the transfer is put down use a good firm backing, either well-rolled card or card mounted on zinc. Before putting down a transfer on aluminium give the plate a wash with weak oxalic acid, or bi-carbonate of soda, and finish with a good rinse of water. For zinc give a wash with alum 20, phosphoric acid 2, water 20. The transfer, when put down on the plate, is gummed up carefully and dried. Wash out with "doctor," clear off gum and surplus ink and roll up sparingly with a rubber roller. Clear the plate with woollen rag and water. Roll up with leather nap roller, dust with talc, and give a weak etch. Finally, roll up and give a strong etch or treatment with "Roderzone" or "Solus" as already described—"Roderzone" No. 1 for zinc, No. 3 for aluminium. The printing should be on damped paper or on crayon printing paper, or on enamelled paper. The ink must be kept stiff and sparing. Herr Gerstenlaur of the Lithochemigraphisches Institute of Gerstenlaur & Reissacher, Stuttgart, has patented the process of preparing the negatives, and they undertake to supply the transfers, with proofs.

The half-tone work executed from aluminium plates by Meisenbach, Riffarth & Co., Berlin, are in themselves proof sufficient what excellent qualities that metal has for such work. It should be remembered that considering the large number of points in a small space, the necessity for printing with a stiff ink, and to obtain a brilliant impression, the speed of the machine must be slackened accordingly. The work produced by the firm in 1902 was of the highest quality, and was not being run at more than 600 per hour.

Of the half-tone methods, or photo-tone methods, applicable to metals, perhaps no process has proved so successful in manipulation or in printing as Frey's Process. Before Frey came back to England he had worked all his experiments at Zurich on stone. But when he brought the process back to England in 1904, the writer at once introduced him to zinc as a medium, and after mastering its peculiarities the process was most successfully worked from it. It is very difficult to tell why large firms have not availed themselves of this process to a much larger extent. The process was patented, and to some extent its operations are secret. The zinc plates are sensitized with a film, soluble in benzol, so that when a photo-print is put

upon them, parts of it may be skilfully wiped off, and in this manner colour stones are readily prepared. Additional work can be made to the plates by medium, crayon or brush; so that the process largely depends upon artistic skill.

There are other methods equally applicable to obtaining photographic work upon zinc and aluminium, notably the "High Light Litho" of F. W. Sears, in which most of the dots in unnecessary parts are eliminated in the early stages. The process is patented and licences granted to those who wish to use it. The examples in *Penrose's Annual* 1906-7 and 1908-9 are sufficient proof of its efficiency.

The use of a Wheeler Metzograph Screen or the Acmetint method (illustrated in "THE BRITISH PRINTER," Vol. xxii., No. 128, April-May, 1909) of producing the negatives has a tendency to make work more suitable for planographic printing. In using this method it is advisable to make positives from the three colours. The negatives should err rather on the soft than the hard side, and, in making them, use a small stop and long exposure, with the screen almost in contact with the plate. In exposing the plate under the negative choose a soft light and give a long exposure.

The new method, patented in 1908 by Arthur Payne, of taking direct photographs upon sensitized copper and zinc through screens, should certainly prove equally effective for half-tone work on zinc for planographic printing, and although the exposure may be long, yet that should be little or no drawback.

The manipulation of obtaining good half-tone transfers for planography has been greatly facilitated by Carl Hentschel Ltd., who now prepare intaglio copper plates, from which the lithographer can pull the transfers.

CHAPTER XV.

Recipes.

1. For cleaning new plates before graining.

ALUMINIUM.

1. Immerse in bath of nitric acid 1, water 2.
or 2. Immerse in bath of nitric acid 1 gal., water 2 gals., alum ½ lb.
or 3. Remove the scale with pumice powder, immerse in bath of caustic potash, and rinse well. Then immerse in bath of either :—
4. Strong nitric acid, hydrofluoric acid, water.
or 5. Strong nitric acid, sulphuric acid, water.
or 6. Strong nitric acid, hydrochloric acid, water.

ZINC.

7. Immerse in bath of sulphuric acid 1, water 100.
or 8. caustic soda 1 lb., water 1½ galls.
or 9. nitric acid 1, water 100.

---

2. For cleaning old work from plates.

ALUMINIUM.

Wash off the ink with benzine or turpentine and carbolic acid, and immerse in a bath of :—

10. Nitric acid ... ... 1 gal.
Water ... . 2 gals.
or 11. Nitric acid ... ... 1 gal.
Alum ... ... 1 lb.
Water ... ... 2 gals.
or 12. Nitric acid .. 1
Water 3

Wash off ink with turpentine or petroleum, with pumice powder rubbed with a felt pad, and follow with wash of benzine ; then immerse in either of the above.

For quick cleaning, after washing ink off, rub well with pumice powder and felt pad and solution of :—

13. Nitric acid ... ... 6 ozs.
Hydrofluosilicic acid ... 10 ozs.
Distilled water ... ... 84 ozs.

or 14. "Solus" with pumice powder. (Messrs. Hunters Ltd.)

After treatments 10, 11, 12, 13 or 14 re-grain the plate.

ZINC.

Wash off old work with petroleum, benzine or turpentine, and carbolic acid.

Treat with, or immerse in bath of:—

15. Caustic soda ... ... 1 lb.
Water ... ... 1½ gals.

or 16. Caustic potash 1
Water 20

or 17. Sulphuric acid ... ... 1 oz.
Water ... ... 1 pt.

or 18. "Solus" with pumice powder.

or 19. Soda, 8 grammes = about ¼ oz.
Water, 1 litre ... = 1¾ pts.

After treatments 15, 16, 17, 18 or 19 re-grain the plate.

If the grain left be good enough for the work to be next put on it may be treated with a mixture of:—

20. Nitric acid .. .. .. 1 gal.
Alum .. .. 1 lb.
Water .. .. 2 gals.

or 21. Alum .. .. 1 oz.
Boiling water .. .. .. 1 qt.
Nitric acid .. .. .. ¼ oz.

Or use the weaker mixture:—

22. Nitric acid 3
Alum 2
Water 720

or 23. Nitric acid 5
Alum 65
Water 1000

Well wash and use again.

---

3. Graining plates.

ALUMINIUM AND ZINC.

Use fine pumice powder, or fine sand, or ground glass.

By hand method use rubber of felt for aluminium; zinc or stone muller for zinc.

By machine method use glass, porcelain or wooden balls.

For hand graining of zinc use sand sifted through 150 or 160 sieve.

The balls for graining may be varied from ¾ in. diameter for fine grain to 1½ in. for medium grain, and 2 in. for coarse grain.

For a plate 30 in. × 40 in., with balls ½ in. diameter, the number of balls may be 7,000.

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4. CLEANING GRAINED PLATES AFTER THE GRAINING PROCESS.

ALUMINIUM.

Rinse well with water, and immerse for a few minutes in :—

24. Nitric acid ... ... 1 gal.
Alum ... ... 1 lb.
Water ... ... 2 gals.

25. Treat with "Solus" solution for one minute.

ZINC.

Rinse well, and treat with :—

26. Alum ... ... 1 oz.
Boiling water ... ... 1 qt.
Nitric acid ... ... ¼ oz.

or 27. Nitric acid ... ... 3 lbs.
Alum ... ... 2 lbs.
Water ... ...720 lbs. (4½ gals.)

or 28. "Solus" solution for one minute.

or 29. Nitric acid 4
Phosphoric acid 1
Water 500

or 30. Nitrous acid 4
Alum.. 8
Oxide or chloride of calcium ½
Sulphate of zinc .. .. .. ½
Water 20

or 31. Bi-carbonate of soda 1, water 30.

or 32. Mixture of nitric and sulphuric acids, and after washing treat with an ammonium salt (not the sulphate), Schœmbs, 1887,

Immerse in :—

33. Nitric acid 4
Phosphoric acid 1
Water 100
} (Forrest and Bucholz, 1893)

Finally treat with alum solution.

For fine grained plates use :—

34. Sulphuric acid 1
Water 100

And finally treat with alum solution.

ALUMINIUM AND ZINC (Patent 10,049, 1899).

35. Immerse in solution of aluminium sulphate and nitric acid, and pass electric current through the bath.

or 36. Immerse in bath of acid sulphate of aluminium, potash alum, nitric acid, phosphoric acid, water.

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5. FINAL TREATMENT OF PLATE BEFORE DRAWING OR TRANSFERRING.

ALUMINIUM.

Roll or compress the plate, to get a finer or coarser grain.

Roll to flatten the points of the grain (Patent 17,647, *1897*).

Plates should always be scoured with pumice powder and felt dabber.

Treat the plate with a wash of:—

35a. Bi-carbonate of soda 1
Pure water 30

or 36a. Weak solution of caustic soda or ammonia liquor.

ZINC.

37. Well rub the surface with tissue paper,

or 38. Rub well with powdered Bath brick and felt pad,

or 39. Rub well with powdered pumice and felt pad.

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6. TRANSFER INK.

ALUMINIUM.

A good stiff ink, made of:—

40. Litho printing ink ... ... ½ lb.
Litho transfer ink ... ... ½ lb.
Calvert's carbolic acid No. 5 ... 5 drops per lb.

And pull the transfers full.

ZINC.

41. Good lithographic transfer ink; and pull the transfers full.

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7. RESISTS.

ALUMINIUM AND ZINC.

42. Finely powdered rosin, and talc (magnesium silicate).

43. Pulverised sensitive bitumen or asphaltum.

44. Pulverised dragon's blood (Sanguis draconis—from Calamus palms; pterocarpus draco, and Dracœna draco).

45. Finely powdered rosin, and silica.

ETCHES.

The word etch usually indicates a corrosion. But in the case of zincography and aluminography, it refers to a chemical action upon the ink, rather than upon the plate, in the case of the first etch applied to new work. In all etches containing gum, add a few drops Calvert's Carbolic No. 2 to each pint.

8. First etch. (for originals.)

ALUMINIUM.

46. Gum solution 12
    20% solution phosphoric acid 1
or 47. Gum water (Baumé 15°) 70
    Syrupy phosphoric acid (Baumé 45°) 1

or 48. "Solus" solution

or 49. Gum solution 50
    Syrupy phosphoric acid .. 1
or 50. Gum solution
    Gallic acid (Strecker, 1892.)
    Ortho-phosphoric acid
or 51. Gall nut solution 5
    Syrupy phosphoric acid .. 5
    Nitric acid 2
    Gum solution 5
    Water 20

9. Second or final etch.

52. Gum solution... 8
    20% solution phosphoric acid 1
or 53. Gum water (Baumé 10° to 12°)... 30
    Syrupy phosphoric acid (Baumé 45°) 1
or 54. Roderzone No. 3 powder ... ... 5 ozs.
    Water ... ... 1 gal.

or 55. "Solus" solution.

or 56. Gall nut solution 5
    Syrupy phosphoric acid .. 5
    Gum solution 5
    Water 20
or 57. Gum solution 8
    20% solution phosphoric acid 1
    Gall nut solution .. .. ½ to 1
or 58. Copper chloride solution, followed by a wash of nitric acid and water (Strecker, 1895).

10. First etch. (for originals.)

Zinc.

Prepare a solution of potassium bichromate 1 oz., in water 20 ozs.

59. 5% solution potassium bichromate ½ pt.
Gum solution ... ... ½ pt.

or 60. Gallic acid 1
Gum solution 8
Phosphoric acid 1

or 61. "Solus" solution.

or 62. "Roderzone" ... ... 60 grammes.
Water ... ... 1 litre.

or 63. Gum solution 8
Phosphoric acid 2
Gallic acid 2

Prepare a solution by soaking 1¼ ozs. to 1½ ozs. gall nuts in 1 pint water. After 24 hours, boil the solution; allow to cool and strain off.

or 64. Gall nut solution ... ... 1 pt.
Gum solution ... ... ½ pt.
Phosphoric acid ... ... ½ oz.

or 65. Gall nut solution ... ... ¾ pt.
Ordinary gum solution ... .. ¼ pt.
Phosphoric acid ... ... 2 drs.

or 66. Phosphoric acid (sp. gr. 1·5) ... 1
Water 1
Gum solution 60

or 67. Gall nut solution 10
Gum solution 20
Phosphoric acid ... ... ¼
Nitric acid ... ... ½

or 68. Gall nut solution .. .. .. 125·5
Nitric acid 30
Phosphoric acid 12
Gum solution 200

or 69. Nitric acid .. .. ¼ oz.
Acetic acid .. .. 4 drops.

or 70. Strong tea solution .. .. .. ¾ pt.
Gum solution .. .. ¼ pt.
Phosphoric acid .. .. 2 drs.
Gall nut solution .. .. .. ⅓ pt.

Parker's Plate Etch :—

71. No. 1 solution .. .. .. 1 oz.
No. 2 solution .. .. .. 1 oz.
Gum solution .. ..16 ozs.

or 72. Parker's Plate Etching Powder. Put 6 ozs. of water in a basin (not in a bottle). Sprinkle 1 oz. of etching powder into the water a little at a time, keep stirring with wooden spatula. Let it stand for 24 hours. When required add 1 pint of water for strong etch, or 2 pints for weaker etch.

or 73. Gum solution .. .. .. 1 pt.
Phosphoric acid.. .. .. ½ oz.

or 74. Very dilute sulphuric acid (Senefelder, 1801).

or 75. Solution of Gum tragacanth.
Nitric acid.
Alum acid.
Hydrochloric acid. (D'Homme, 1852.)

11. Second or final etch. (etch for transfers.)

76. Gallic acid ... ... 1 oz.
Phosphoric acid ... ... ½ oz.
Gum solution ... ... 1½ pts.

or 77. The gall nut etch No. 64 or 65 of about half strength.

or 78. Roderzone No. 1 powder ... 5 ozs.
Water ... . 1 gal.

or 79. "Solus" Solution.

or 80. Tutzschke solutions (Patent, 1907).

or 81. Parker's Plate Etch, solution or powder.
or Treat the plate with a silicate (Dickes, 1884).

or 82. Gall nut solution .. .. 1 pt.
Gum solution .. .. .. ½ pt.
Phosphoric acid .. .. .. 4 drs.

or 83. Gum solution .. .. .. 1 pt.
Phosphoric acid .. .. .. 1 oz.

or 84. Ammonium silico-fluoride 1 oz.
Ammonium nitrate .. .. 1 oz.
Gum solution .. .. ..100 ozs.
Water .. ..900 ozs.

or 85. Water 2
Thick gum 3
Transfer acid MH, 4 per cent solution 1
(This MH is apparently the Roderzone etch.)

or 86. Thick gum arabic solution 75
Saturated alum solution.. 25
Nitric acid .. .. .. 3 to 5

In making etches it must be remembered that as water is repelled by grease, when an etch is made of water and acids,

or even a very watery solution of gum, that the grease on the plate will repel such an etch and leave a halo of light all along the margins of the work. The actual edges will therefore be insufficiently etched, and ultimately have a feathered appearance. By using thicker gum solution, the adhesive of the gum will resist this repulsion, and will assist greatly in efficient etching. Water etches, therefore, must be kept continually in motion on the plate to prevent this defect.

12. Etch for giving relief.

87. Alum 1,500
Water 10
Nitric acid 15

The well-rolled up plate, dusted with rosin and talc and warmed is placed in a rocking bath and etched from 4 to 12 minutes. Remove, wash, wipe and dab out any water and sediment; apply an ordinary second etch for zinc and leave on 5 minutes. Rinse well, wipe and dab dry and gum up well. After one hour's rest, wash out with Cornelian tinktur ("doctor"), fan dry, and proceed to prove.

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13. DOCTORS.

The washing-out fluids, which have been in use many years, were originally applied much in the way the doctor gave physic to a weak patient. The term "doctor" was applied at least twenty years ago, probably more, and as it is a convenient expression is adopted in this treatise for all the special washing-out or strengthening fluids.

Recipes.

Add artists' crayons to turpentine to make a saturated solution.

or 88. Turpentine 1 pint, in $1\frac{1}{2}$ pint bottle, add crayon parings until it will not dissolve any more. Strain off the liquid and add to it sensitive bitumen or asphalt, 1 oz.,

or 89. Similarly saturate 1 pint turpentine with beeswax; strain and add 1 oz. bitumen.

or 90. Jew's pitch powder ... ... 100 grammes.
Rectified benzine ... ... 200 grammes.
Essence of turpentine ... ... 800 grammes.
Draughtsman's ink ... . ½ stick.

or 91. Asphaltum powder .. .. .. ½ lb.
Benzole .. .. ⅓ pt.
Yellow wax .. .. 2 ozs.
Tallow .. .. ¼ lb.
Oil of lavender .. .. 2 pts.
Turpentine .. .. 1 oz.

or 92. Yellow wax 150
Venice turpentine 200
Oil of tar 50
Black ink 250
All well melted, then add :—
Pulverised asphalt 500

or 93. Asphaltum .. .. 2 ozs.
Stearin .. .. 1 oz.
Beeswax .. .. 1 oz.
Oil of lavender .. .. 10 ozs.
Re-transfer ink .. .. 2 ozs.
Turpentine .. .. 20 ozs.

or 94. Syrian asphalt .. .. 400 grammes.
Oil of turpentine, or polish turps 400 grammes.
Rectified turpentine, French .. 150 grammes.
Litho varnish .. .. 25 grammes.
Anhydrous benzol (benzine) .. 40 grammes.
Yellow wax .. .. 20 grammes.

or 95. Asphalt 500
Yellow wax 125
Talc 125
Oil of lavender 20
Turpentine 3,000

NAMES OF "DOCTORS" MANUFACTURED FOR SALE.

Washing-out liquids sold by dealers in zinc and aluminium plates :—

Lithophile (Clarkson).
Lithophine (Berger & Wirth).
Bringupine (Hughes, Treleaven & Co.)
Phirmold (C. G. Röder, Ltd.).
Mogul (Penrose & Co.).

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14. RE-SENSITIZING FOR CORRECTIONS.

ALUMINIUM.

After taking out the work with concentrated sulphuric acid, rinsing and drying, treat with :—

96. Saturated solution of oxalic acid ... 4
Water 96

or 97. Saturated solution oxalic acid ... 4
Pure nitric acid 4
Distilled water 90

or 98. "Solus" solution for one minute and wash off clean.

or 99. Powdered whiting, whitning or whitening rubbed with felt and a little water.

or 100. Water 1,400
Acetic acid 40
Nitric acid 20

or 101. Aluminium sulphate 200
Water 400
Alcohol 30
Hydrofluoric acid 15

or 102. Aluminium sulphate .. 1,300 (aluminium sulphate, 1¼ lbs.,
Hydrofluoric acid .. 50 in H_2O, 3½ pts.)
Absolute alcohol.. .. 50

ZINC.

After cleaning off the gum, and treating with very dilute sulphuric acid.

103. Powdered whiting, rubbed with a felt stump and a little water.

or 104. Nitric acid ... ... ¼ oz.
Alum ... ... 1 oz.
Water ... ... 1 qt.

or 105. "Solus" solution for one minute and wash off clean.

or 106. Dilute acetic acid.

or 107. Hydrochloric acid 2½
Water 200

108. If work has to be entirely removed, wash it out with turpentine and eradicate it with weak caustic soda solution, or 5% caustic potash solution, and re-sensitize as above.

109. If new ink work is to be eradicated, rub it off with india-rubber or ink eraser, or take it off with brush and benzine.

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15. OFF-SETS.

Use a fine hard glazed brown paper, or a fine flint, or steel blue paper.

ALUMINIUM AND ZINC.

110. Aniline colour and magnesia.

or 111. Mixture of sienna, Frankfort black.

or 112. Sienna, bronze blue.

If the first be used, a very thin wash of turpentine should be given to the plate.

113. "Paramount" (Horsells & Co.'s) permanent off-set powders.
or 114. Renova or Standphast permanent off-set powders.

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16. To keep plates clean in printing.

ALUMINIUM.

115. Weak solution of bicarbonate of soda.
or 116. Roderzone No. 4 powder 1 lb., warm water 1 gal.
or 117. Very weak solution of caustic soda, most carefully used.

Or for plate edges :—

118.	Saturated sol. oxalic acid	4
	Nitric acid	4
	Distilled water	90

Or for obstinate patches of dirt rub with :—

119.	Sienna powder	1
	Sulphuric or oxalic acid	2

or 120. Occasional treatment with "Solus" solution.

ZINC.

By adding to damping water :—
121. Strong solution of tea.
122. Gum solution.
Make stock solutions of :—
123. 16 ozs. chromic acid in 16 ozs. water.
$4\frac{1}{2}$ ozs. phosphoric acid (85%) in $11\frac{1}{2}$ ozs. water.
Take 1 oz. of each and add to 16 ozs. gum solution, and use about 1 oz. of this to a gallon of the damping water.
124. Weak tannic acid.
125. Weak tartaric acid.
126. Weak calcium nitrate.
127. Golden syrup.
128. Brown sugar.
Or to remove scum use :—
129. 5% solution potassium bichromate.
or 130. Weak solution of bicarbonate of soda.
or 131. Weak solution of caustic soda or caustic potash.
or 132. Roderzone No. 2 powder 1 lb., warm water 1 gal.
or 133. Occasional treatment with "Solus" solution.
or 134. Caustic soda "sticks" $2\frac{1}{2}$ ozs., water 1 pint.
or 135. Rub gently with pumice powder and gum water.
or 136. Add to the printing ink a little magnesia or starch.

CHAPTER XVI.

Treatment of Zinc Briefly Tabulated.

NEW POLISHED PLATES.

1. Immerse in caustic soda bath.
2. Wash; dry.
3. Grain in mechanical grainer; wash and dry.
4. Immerse or treat with nitric acid, alum, water.
5. Dry, then

DRAW ORIGINAL WORK, INK AND CRAYON.

6. Etch: potassium bi-chromate and gum (1st etch).
7. Wash off with gum water; dry.
8. Gum thinly and evenly; dry.
9. Wash out with "doctor" or turpentine.
10. Roll up solid or not, if "doctor" has been used.
11. Wash off gum and ink with clean rag.
12. Roll up in good ink; dust with rosin and talc.
13. Etch: potassium bichromate and gum or "Roderzone."
14. Wash off; dry; gum up; dry.
15. Wash off gum and prove.

TRANSFER ON ZINC.

16. Gum up; dry.
17. Wash out with "doctor" or turpentine.
18. Roll up solid or not, if "doctor" has been used.
19. Wash off gum and ink with clean rag.
20. Roll up in good ink; dust with rosin and talc for etch.
21. Etch with No. 76 recipe, or "Roderzone."
22. Wash off; dry; gum up; dry.
23. Prove.

ADDITION ON ZINC.

24. Wash off gum; roll up stiff; dust with talc.
25. Wash with nitric acid, alum and water.
26. Scrape whitening on, sprinkle with water and rub with felt stump two to three minutes.

27. Wash off clean; make new drawing or transfer.
28. New drawing treat as 6-15.
29. Transfer treat as 16-23.

ALTERATION ON ZINC.

30. Wash off gum; roll up stiff; dust with talc.
31. Wash out part to be altered with turpentine.
32. Treat same place with strong caustic soda.
33. Prepare with weak sulphuric acid or as 25 above.
34. Dust with whitening as 26.
35. As 27, 28, 29.

REMOVING WORK FROM PLATE.

36. Wash with turpentine.
37. Treat with caustic soda.
38. As 2, 3, 4, 5.

Treatment of Aluminium briefly Tabulated.

NEW POLISHED PLATE.

50. Immerse in nitric acid, alum, water.
51. Wash; dry.
52. Grain in machine.
53. Immerse in nitric acid, alum, water.
54. Thoroughly wash.
55. Wash; dry.
56. Rub well with pumice and felt pad, then

DRAW ORIGINAL WORK, INK AND CRAYON.

57. Dust well with rosin and talc; warm the plate.
58. Etch with phosphoric acid and gum (1st etch).
59. Wash off and gum evenly and dry.
60. Wash out with "doctor" on dry gum.
61. Wash off gum and film of "doctor."
62. Roll up with stiff ink; dust with rosin and talc.
63. Etch with phosphoric acid and gum, or "Roderzone" (2nd etch).
64. Wash off; gum thinly; dry.
65. Prove.

TRANSFER ON ALUMINIUM.

66. Rub well with pumice powder and felt pad.
67. Treat with carbonate of soda solution.

68. Put down the transfer; wash off with warm water.
69. As 57-65.

ADDITIONS ON ALUMINIUM.

70. Wash off gum; roll up stiff; dust talc.
71. Prepare with No. 96 recipe.
72. Scrape whitening on parts for addition; sprinkle water and rub with felt stump three minutes.
73. Wash off; dry.
74. Draw or transfer the addition.
75. New drawing treat as 57-65.
76. New transfer treat as 57-65.

ALTERATION ON ALUMINIUM.

77. Wash off gum; roll up stiff; dust rosin and talc.
78. Remove work with concentrated sulphuric acid.
79. Wash off clean.
80. Treat with nitric acid, alum, water and whitening as 72.
81. As 73-76.

REMOVING WORK FROM PLATE.

82. Wash off work with turpentine or petroleum.
83. Rinse well with water.
84. As 50-55.
85. Always rub over any plate, new or old, with pumice powder and felt pad, before use.

CHAPTER XVII.

Photography upon Aluminium and Zinc.

THE use of metal plates has not only proved useful for the support of collotype films instead of glass, but it has been extended to the treatment for direct photo-printing surfaces, such as have been obtained through photo-lithography.

ALUMINIUM.

The treatment of aluminium recommended by George Fritz, of Vienna, is as follows :—

Prepare a solution by soaking

A Cologne glue ... ... 25 grammes (386 grains).
Water ... ... 150 ,, ($\frac{1}{4}$ pint).
for twelve hours. Then reduce it to liquid by a gentle heat.

Add to this fluid a mixture of :—

B Albumen ... ... 3 grammes (46$\frac{1}{4}$ grains).
Water ... ... 30 ,, (about 8$\frac{1}{2}$ drachms).

In three to five minutes little white flakes appear. Filter through cotton wool, and proceed to make the complete coating solution by taking of :—

Cologne glue solution (*A and B*) 30 grammes (about 8$\frac{1}{2}$ drs.).
Albumen ... ... 12 ,, (185 grains).
Water ... ... 60 ,, (about 17 drs.).
Ammonium chromate ... ... 6 ,, (92$\frac{1}{2}$ grains).
Water ... ... 500 ,, (about 17$\frac{1}{2}$ ozs.).

The mixture must be filtered through filter paper, and should be golden yellow, ready for coating plates.

ZINC.

A process described by H. Schmieder in his patent 24,934, *1899*, is to treat the grained zinc plate with weak nitric acid, wash and dry. Warm the plate and coat with a film of :—

Albumen
Saccharic acid
Water.

When dry, pour on a mixture of:—

Zinc chloride
Chrysaniline
Ammonium bichromate
Potassium ,,
Water.

After exposure roll up with an ink of lampblack, wax, Venice turpentine, litho printing ink and oil of lavender melted together, and mixed with asphaltum or rosin, and pure beef fat.

Develop in water and gum up. Wash out with turpentine or "doctor"; then remove the unnecessary film with weak nitric acid, roll up and etch.

An etch suitable may be:—

Gall nut solution	½ pint
Ordinary gum solution	2 pints
Phosphoric acid	2 ozs.

The patent of J. Schmidt and R. Gruber (14,513, *1906*) for photo work on zinc, consists of cleaning a plate with sulphuric acid and emery or pumice powder, and then with a mixture of hydrochloric acid, alum and water. The plate is dried and coated with gelatine and ammonium bichromate. After exposure it is developed in water, dried and powdered with Syrian asphalt, which is heated until melted. The asphalt adheres to the unexposed parts of the film. The exposed parts are removed with hydrochloric acid, water and gum. The plate is treated with turpentine and sulphuric ether, and finally rolled up.

In using plates for direct photography, the recipes for the sensitizing films must be carefully carried out. The film should be dried in a dark chamber and kept in the dark until required. As the picture on the plate must be reversed right to left, a reversed negative must be used. The printing frame must be of the special construction made for the purpose. The front of the frame is plate glass, and upon it the reversed negative is placed face up: upon this is placed the sensitive film on the metal plate. The whole is made secure with a layer of felt and thick blotting paper, upon which the wooden back is placed and held in position by the crossbars fitted to the frame. The frame is then turned over and exposed to light, the exposure being timed by an actinometer. This matter is dealt with later in the chapter.

USING ZINC FOR PHOTOGRAPHING ON.

Other than what might be termed the pure photographic method, both zinc and aluminium are readily adaptable for direct photographic copying in a photographic printing frame, owing to their pliability and thinness. The method of copying upon zinc, any drawing upon tracing paper, or upon ordinary paper is by simply sensitizing the zinc with any suitable half-tone process film, and placing the actual face of the copy against the sensitive film of the zinc, placing them in a photo-printing frame and exposing them to daylight or artificial light, when an effect is produced on the film from which either a positive or negative (transposed) result may be obtained. This process is similar to the Vandyke process.

A thoroughly cleaned, fine-grained or polished plate may be coated with any of the following sensitive films :—

Fish glue	100 c.c. (about $3\frac{1}{2}$ ozs.)
Ammonium bichromate ..	25 grms. (386 grains.)
Liquor ammonia (·880)	5 c.c. (77 grains.)
Water	400 c.c. (about 14 ozs.)

Fish glue	1 oz.
Amm. bich. 20% sol.	2 ozs.
Chromic acid 10% sol.	5 minims.
Water	6 ozs.

Fish glue	5 ozs.
Amm. bich	$\frac{1}{4}$ oz.
Water	100 ozs.
Liq. ammonia	

Water	2 oz.
Egg albumen	96 grains.
Amm. chromate	$14\frac{1}{2}$,,
Fish glue	19 drops.

Fish glue	$2\frac{1}{2}$ ozs.
Whites of	2 eggs
Amm. bich.	60 grains
Water	5 ozs.

White of ... ... 1 egg
or 10 grains dried albumen
Water ... ... 1 oz.
Potassium bichromate ... ... 10 grains.
Liq. amm. ... ... q.s.
To which may be added
Fish glue ... ... 100 minims.

Water ... ... 7 ozs.
Albumen of egg ... ... 1 oz.
Amm. bich. ... ... 32 grains
Liq. amm. ... ... 2 or 3 drops.

Water ... ... 1000 grains.
Albumen ... ... 100 ,,
Amm. Bich. ... ... 3 ,,
Liq. amm. ... ... q.s.
to give light yellow.

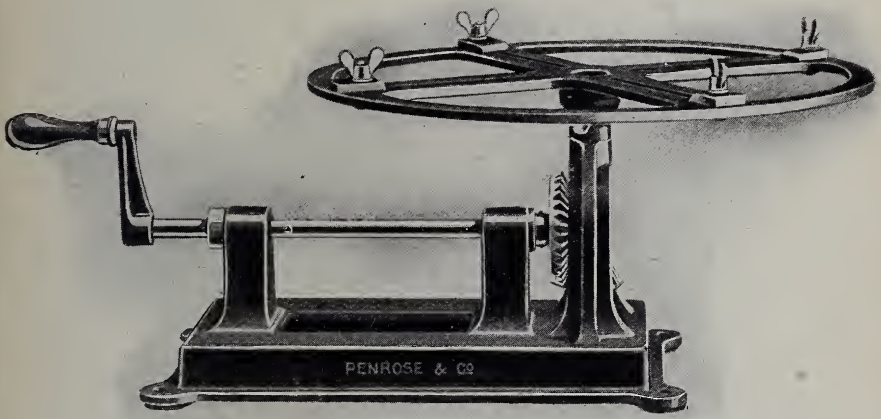
G. Fritz's formula already described.

Whites of ... ... 2 eggs.
Amm. Bich. ... ... 6 drachms
Water ... ... 14 ozs.

Water ... ... 912 drops
Enamel glue ... ... 1 oz.
Cologne glue ... ... 24 grains
Amm. bich. ... ... 29 ,,
Ammonia .. .. 5 drops.

In all cases the fish glue makes a film more soluble and suitable for the Vandyke process. The liquor ammonia is added in all cases to turn the dark colour of the solution to a pale yellow. It is added drop by drop until the desired effect is obtained.

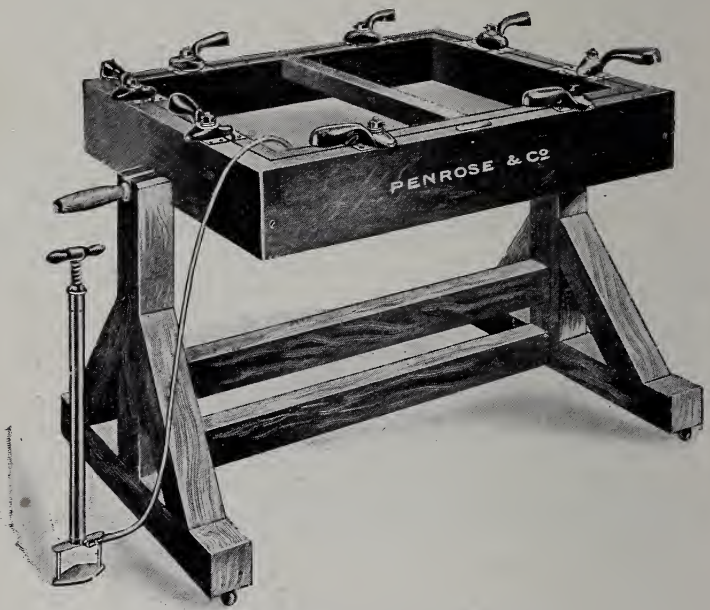
Having sensit.zed the zinc (or aluminium) in a dark room, using a whirler to obtain an even thin film, it is dried in the dark room and is ready for exposure. Penrose & Co., Ltd., 109 Farringdon Road, London, and other photo-sundry dealers, supply large whirlers, similar in working to the model constructed by the writer in 1888, suitable for zinc and aluminium plates. The construction is a skeleton bedplate apparatus, with the whirler in a horizontal plane, so that pouring on the liquid and watching its distribution is a mechanical operation rendered as easy as could be desired.



Whirler for Coating Films on Plates.

The print or drawing is placed in the photo-printing frame with its back on the plate glass. Upon this is placed the sensitized film side of the zinc (or aluminium) plate, and upon that the necessary layers of felt to reach the backing boards. These are fastened and the frame turned over to expose the plate-glass front to the light. The exposure varies so much that no time can be stated ; some experience with different lights,

and different papers used as the copy, together with an actinometer is the best test. A simple actinometer can be made by fastening layers of tissue paper upon one another, each layer being, say, $\frac{1}{2}$ inch shorter than the one before. If nine layers are used it will test for nine equal (or nearly equal) tints. These layers can be made to fit a $\frac{1}{4}$-plate photo-printing frame, and



Pneumatic Photographic Printing Frame.

the time tests recorded upon ordinary P.O.P. or silver photographic positive paper, obtainable from photographic dealers in packets at cheap rates. With such an actinometer it need be simply exposed, and a given depth of colour (black) registered as the light penetrates one thickness of tissue paper, then two thicknesses and so on. In time a record can be made for say

six or eight different papers. And it does not matter what light the exposure is made in, the actinometer registers the tints according to the light used, and the number of tints required must be judged accordingly.

After exposure the photo-print may be used to either obtain a negative (or transposition) or a positive picture.

For a negative (transposition)—giving black in place of the white of the original—proceed to roll up the whole plate, using a composition roller, until solid. The ink should be a good photo-litho-transfer ink, or a good semi-protective transfer ink made of equal parts of transfer and printing inks with small additions of Burgundy pitch or asphaltum, wax and palm oil, with a solvent essential oil—either rectified turpentine or oil of lavender. Thin it down with turpentine and roll up the plate with a thin, grey film, as in rolling up a photo-litho transfer. The inked plate is immersed in water—not necessarily quite cold—and with a tuft of cotton wool the surface is gently rubbed. In a few minutes the original sensitive film, which has not been acted on by light, will dissolve gradually and leave the plate. In due course it will become practically clear, leaving the film which has been acted upon by light passing through the "whites" of the paper, with the layer of ink on it. The actual drawing or print transposed may require a little clearing. The plate is then well rinsed under water, and any little re-touching may be done.

The plate is now treated as a transfer upon zinc. It is gummed up, fanned dry. Wash off the gum, roll up in stiff ink, dust with rosin and talc (French chalk); finally, clear the lines of any dirt with charcoal stick and pumice, and etch with any of the second or final etches for zinc. If the photo production is upon aluminium treat as a transfer on aluminium (see p. 41, Chapter X).

After the necessary etching and rolling up, the plate is ready for proving.

THE VANDYKE PROCESS.

For a positive, giving an exact replica of the original copy, take the plate after exposure and give a good wash under a tap, and flow upon it a little aniline colouring—red or blue—as supplied by photo-process sundrymen, or made of pure crystal violet 100 grains, water 1 pint. This colours the film and

shows the picture as printed in negative by the light stronger than the parts not photo-printed. It is these latter parts that must now be removed. Treat the plate with 1% solution of ammonia and dry it. A further soak in cool water, together with gentle rubbing with cotton wool, will remove the unhardened film and leave the zinc bare where the original copy shielded the action of light. The plate is dried and gently rubbed over with pumice powder and cotton wool, followed by whitening and cotton wool, when it may be drawn upon with ink, or parts not required may be gummed out. When ready

Acid Trough for Developing and Etching Plates.

treat the plate with a "doctor"; then roll up solid all over with a good re-transfer ink thinned with turpentine, or with an ink of bitumen 4, litho writing ink 1, dissolved in benzole and turpentine, until there is a thin grey film. Use a composition roller. After rolling up allow to stand for one to two hours.

The final development of the plate is by immersing the plate in a very weak bath of water 100, hydrochloric acid 2,or perchloride of iron, or other agent which will attack the zinc and release the film. After a few moments' immersion take it from the bath, wash well with water, and rub gently with a pad of cotton wool until the whole of the film acted on by light—the only part of the film left on the plate—is removed. A gentle rub over with cotton wool and soft powder, such as tripoli, or sienna, will remove the remaining bits of film as well as any inky scum.

Then dry the plate, dust with rosin and talc, and etch with

any of the second or final etches for zinc, laid on with a brush. After etching wash well, dry, gum up, fan dry and treat with "doctor" on the dry gum. It is then ready for proving, and will give the print as a facsimile of the original copy.

A variation of this process may be made by using a polished zinc plate and sensitizing it. Dry it by a little warmth. Expose under a positive and roll up with a thin film of good transfer ink. Immerse in warm water and develop the picture by rubbing gently with cotton wool. The result is a negative (transposition). Immerse the plate in perchloride of iron (Baumé 35°) for about twelve seconds, wash well and dry. The plate may be rolled up solid with transfer ink, or the etched lines may be filled with "doctor." If rolled up it must be solid, and finished with a smooth roller to show the etched work. The albumen sensitizer on the plate under the negative picture is removed by gently dissolving it, by rubbing the surface with a pad of muslin and caustic ammonia. The whole of the ink and albumen under it will thus be cleared off, leaving the positive image, clean and sharp, to be rolled up, dusted with rosin and talc and etched for proving.

Another method for both line and half-tone work is to use polished zinc, thoroughly cleaned with benzine. Coat the plate in a whirler with sensitive asphalt dissolved in benzol. The plate should have a golden appearance, and can then be exposed in a printing frame under a reversed negative. The exposure must be timed by an actinometer. After exposure place in a dish and develop with rectified turpentine. If it is difficult to develop use some Russian turpentine. After development wash well, and put it in the whirler to throw off the water, then dry it in sunshine or strong artificial light for $\frac{1}{4}$ or $\frac{1}{2}$ hour respectively. When dry immerse in 1% solution of nitric acid for one minute. Well wash, drain, fan dry, gum up and dry quickly. After standing some time commence rolling or rubbing up, using a little palm oil if necessary. After inking up wash well, dry quickly, dust with rosin and talc, etch and gum up.

Finally, upon the dry gum, wash out with "doctor" and roll up, leaving the plate an hour or two before proving. Should it scum in printing give a weak etch.

The Vandyke Process as practised by Mr. James Crawford and as described by Mr. Ernest Grills in the *Process Monthly* of August, 1907, is practically as follows :—

The zinc plate may be well polished for relief etching, or matt-grained for lithographic treatment. Coat in a whirler, with the sensitive film of:—

Fish glue	100 c.c. (about 3½ ozs.).
Amm. bich.	25 grammes (386 grains).
Ammonia ·880	5 c.c. (77 grains).
Water	400 ,, (about 14 ozs.).

or

Fish glue	1 oz.
Water	6 ozs.
20% amm. bich. sol. ...	2 ,,
10% chrome acid sol. ...	5 minims.

When coated, dry over moderate heat. It is then ready for exposure. Use a large metal plate photo-printing frame. Place the printed original to be copied, or the drawing, on white paper, or on tracing paper, on the plate glass in the frame, face upwards. Upon the paper copy lay the sensitized side of the zinc, thereby coming into contact with the original copy. Close the frame and secure perfect contact. Expose to light. It is more under control if electric light be used. As a guide for exposure, it may be stated that with a 200 volt 6 ampère lamp the exposure through ordinary white wove paper would be ten minutes at two feet distance. But the best guide is to expose a piece of exactly similar paper in a small printing frame, with ordinary P.O.P under it, and register the exposure by that.

After exposure, let a stream of water run gently all over the plate for a period not exceeding one minute. The fish glue is rather too soluble to withstand much of this treatment.

Having washed the plate flow on or immerse in a bath of dye, of:—

Patent crystal violet ...	100 grains
Water	20 ozs.,

which stains the exposed parts more deeply than the unexposed in about half a minute. Again wash with a gentle stream of water and dry in the whirler. The positive picture—being the copy of the original—should now be almost, if not quite, bare metal. The lines may require developing out with cotton wool and water, gently rubbed to remove the remaining film. The plate must next be prepared in a bath of:—

Perchloride of iron, 45° B	1 oz.
Water	20 ozs.

or

Alum	1
Nitric acid	4
Water	40

The plate must be immersed, and by experience it will be found how long it should remain. About one minute and not exceeding two minutes in most cases. This perchloride bath also removes nearly all the stain if made as above. The plate is again washed for two minutes, and thoroughly dried on the whirler. It should then be finished off over gentle heat. The plate is ready for inking up. The ink used is a strong transfer ink of the nature of a "doctor." Its composition is :—

Best litho printing ink ...	6	melted together and well mixed.
Litho writers' ink	2	
Hard plate transfer ink ...	2	
Bitumen	1	dissolved in chloroform and benzol.
Yellow lump rosin	1	

After melting and well mixing, allow to cool somewhat and add the rosin solution.

Or the ink may be :—

Bitumen	4
Litho writers' ink ...	1

dissolved in benzole and turps.

With such an ink, thinned, and rolled up with a moderately old hard composition or gelatine roller, it is possible to roll on the plate a fine, thin, even grey film all over. Warm the plate slightly and allow to cool. At this stage Mr. Grills proceeds to treat with water and develop the positive image with tuft of cotton wool and water, finally dusting the work with a resist prior to etching for line block. In lithographic treatment, after rolling in the ink, it is much better to allow the plate to stand for one to two hours. At the end of that time immerse the plate in very dilute hydrochloric acid ½ oz., water 1 gallon, and develop with cotton wool, gently rubbing away the film that was acted upon by light. The film very soon comes away and the plate can be removed from the bath, washed, and printed from as an original on zinc. It should be pointed out that fish glue is much more soluble than "albumen" film. With the

latter it would be difficult to obtain a satisfactory result. Albumen film is suitable for hot climates.

To roll up a plate thus prepared, proceed to etch with gum solution 3 pints, gall-nut solution 1 pint, phosphoric acid 3 ozs. This may be applied with a camel hair brush, and finally smoothed over with the special cloth kept for the purpose. After a few seconds wash off with water; fan dry; gum thinly; fan dry; wash out on the dry gum with: powdered asphalt 1 oz., tallow ¼ lb., beeswax ¼ lb., oil of lavender ¾ oz., turpentine 5 ozs., using a soft flannel to rub it over. Leave the plate exposed with this solution on for an hour. Wash off with clean flannel and water; roll up; remove dirt or grease spots with caustic potash, 3 ozs. in ¾ pint water, reduced in strength to just remove the scum. It should be applied with a quill, blotted off, washed clean, fanned dry and etched. Should any part appear weak, gum up, fan dry and wash out with "doctor." After all final treatment the plate is ready for printing.

The following recent method of using a grained screen for direct photo-printing on metals has been communicated by Messrs. Penrose & Co.

GRAINED PRINTS FROM GRAINLESS NEGATIVES BY THE METZOGRAPH SCREEN.

The Metzograph screen may be used for the production of ordinary printing blocks or for photo-lithography, by printing direct from a continuous tone negative with very successful results, especially in the coarser grains, which are particularly adapted for this class of work. Coarse grain blocks may be made for newspaper printing or other rough purposes, and for photo-lithography in both monochrome and colour the screen is of great economical value. The results are similar to those produced by the reticulation of gelatine, whilst being much simpler to produce they have also the great advantage of always being in perfect register. For colour work a number of prints may be obtained from one negative and these worked upon by a chromo-lithographic artist, or colour selection negatives may be used and printed from direct; in any case the grain is easy to print and is always of a pleasing character.

The Negative. As has already been stated a continuous tone negative is required, but this must be specially made, because ordinary negatives which are used for photographic printing are too brilliant. A negative for the purpose should be extremely soft and delicate and quite free from fog, so that it will print in the minimum time. A wet collodion or collodion emulsion negative slightly intensified with pyrogallol and silver nitrate gives the necessary range of gradation for satisfactory work. A "thin" correctly exposed dry plate negative is also satisfactory.

The method of producing the grained print is to print the negative on to a piece of metal sensitized with bichromated albumen, placing the metzograph screen in the printing frame in front so that the light must first pass through it. The most essential point is, that the light shall strike the negative as parallel pencils, which result may be obtained by printing in direct sunlight (not diffused light); it is necessary to exclude the remainder of the daylight so that a special printing device is necessary, which is furnished by the Wheeler printing box. The printing frame containing the screen with the rough surface towards the negative, the negative and the sensitized metal is placed in a drawer and the box is arranged at the necessary angle as regards the sunlight, in other words the surface of the printing frame is disposed at right angles to the light rays. The amount of inclination can be regulated by screws. Several diaphragms are placed at intervals inside the box for the purpose of preventing any scattered light reaching the plate.

The printing may also be effected by an arc lamp, but the exposures are longer than to direct sunlight because of the necessity for the printing frame being placed at a considerable distance from the light source. The best results are obtained with an open type arc lamp because the area of the arc is very much less than with an enclosed type lamp. When printing by artificial light the printing box may be dispensed with, but the frame should not be at a less distance than 4 feet. The printing frame should have only a light *spring* pressure in order that there may be no risk of breaking the screen. Excessive pressure is quite unnecessary.

Exposure. The actual exposures vary when printing in direct sunlight from 1½-5 minutes according to the time of year.

No portion of the exposure may be made to diffused light. When printing by an open type arc lamp taking 15 ampères the exposure is approximately 30 minutes at the distance of 4 feet. The printing frame or printing box must on no account be moved during the exposure, because a confusion of the grain follows, which is fatal to successful work.

Making the print. The method of working the bichromated albumen process is well known and it is well adapted to any process of direct photo-lithography in line or in half-tone in which the grain is not very fine ; it will be found to work well for the metzograph screens Nos. oo, o, and 1, which are the most useful grades for the purpose.

An outline of the points in working the bichromated albumen process which require special consideration for the work may be useful to some workers.

The printing surface is usually zinc or aluminium because of their convenience, although satisfactory results may be obtained with lithographic stones. Either zinc or aluminium prepared litho plates (such as Penrose's litho-zinc and aluminium plates), will be found suitable, or zinc may be grained and prepared in the usual bath of nitric acid, alum and water. After sensitizing and exposure in the manner already described, the plate is rolled up with a thin layer of re-transfer ink thinned with coal tar naphtha (turpentine may be used, but is not so satisfactory for the particular purpose). The metal is placed in water for development, during the early stages of which the plate should be kept entirely under the water, because if any drops collect on the otherwise dry surface uneven markings will result which cannot be removed. When the development is completed in the ordinary way, the plate may be removed from the water and any portion which is required to be made lighter can easily be reduced to the desired extent by rubbing somewhat harder with the cotton wool. Any work to be entirely removed should be rubbed away with soft willow charcoal.

The plate is now dried, and in order to thoroughly fix the work it may be dusted with bitumen powder and glazed over the gas stove; if this is done the metal should be again thoroughly "etched" before handing to the lithographic printer, because the surface is liable to be covered with a tenacious scum. In this condition the print, if it has been

prepared on ordinary process zinc, may be etched into relief. Instead of applying bitumen the plate may be gummed in with a thin layer of freshly prepared gum arabic solution which is entirely free from acid, and allowed to stand for an hour before passing to the printer.

CHAPTER XVIII.

Rotary Machines for Metalography.

THE L. & M. LITHOGRAPHIC ROTARY.

Specially contributed by the LINOTYPE & MACHINERY LTD.

THIS machine, which has been before the trade since early in this century, has been designed with the object of meeting all the needs of the printing firms, who wish to keep abreast of the times in quality as well as speed of production. It is constructed for both zinc and aluminium plates, and is well built in all particulars. Even short runs can be advantageously manipulated upon this machine, owing to the readiness with which plates can be changed.

In designing the L. & M. machine every effort has been made to simplify it, and reduce the number of its adjustments. The impression and printing cylinders are of the same size, and accuracy in turning the surfaces has been further ensured by conducting this operation with the cylinder actually rotating in the same bearings as supplied on the finished machine, rather than turning upon a centre point. Moreover, the cylinders are afterwards ground perfectly true. The grippers are fitted with a safety tumbler to prevent breakage if left open when starting the machine. The clamps for holding the plate are machine finished and grip with perfect evenness, and whilst fitting a plate in they are automatically kept open.

The accessibility to the plate is one of the principal advantages of this machine, and the backing-up motion, actuated by a foot lever, is of the greatest value, as it abolishes the necessity of turning the flywheel by hand. This motion can be controlled from the feeder's stand also.

The makers of this machine realized the necessity for the finest adjustment of the damping apparatus, as they found

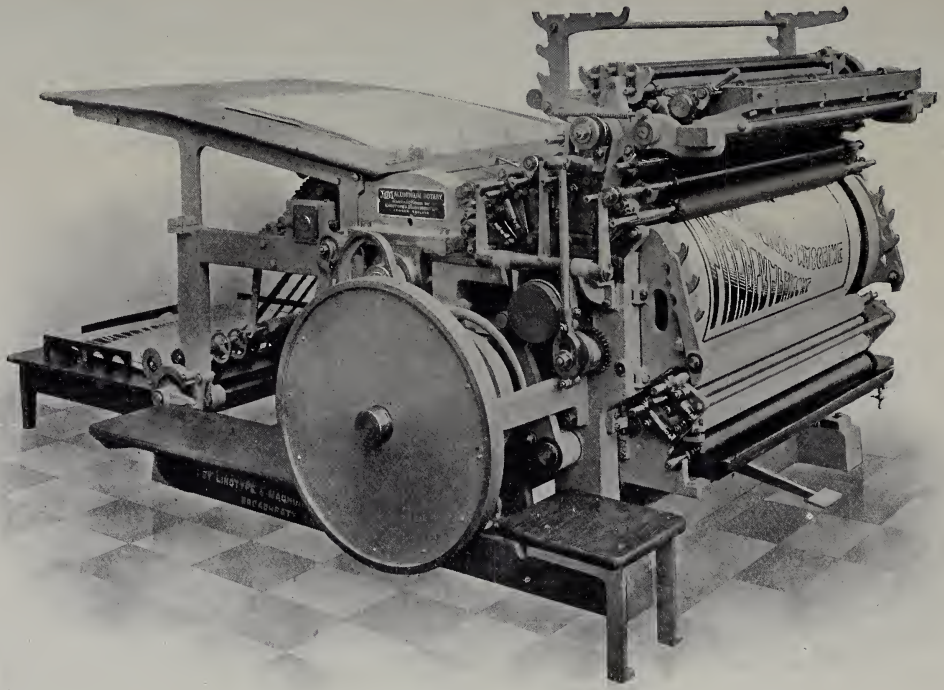


Plate Rotary of Linotype & Machinery, Ltd.

that the proper quantity and evenness of damping are most important factors in plate printing. The damping apparatus is adjusted so that when the cylinder is "tripped" (stopped) the supply of water is also checked.

The duct roller is automatically held in contact with the distributing cylinder when the printing is checked, and the (plate) inkers are automatically raised from the plate. This automatic raising of rollers and tripping of cylinder is operated by one mechanism, which renders it impossible for the rollers to be accidentally or carelessly left on the plate when the machine is stopped. The rollers which receive the ink from the distributing cylinder and pass it on to the inkers—called transfer rollers—are of large diameter. The inkers have long spindles, can be easily adjusted on each side of the machine, and can be raised by hand adjustments. Another distinctive feature is the facility with which the distributing rollers are raised from the cylinder when the machine is stopped, consequently there is no extra strain on the gears when re-starting.

A safety device is fitted to the flyers to prevent breakage of the cam lever; and the delivery table is at a convenient height for inspection and for removal of the prints.

The speed of the machine is only limited by the ability of the layer-on. The machine is made in four sizes for work on the plate measuring from 31×41 ins. up to $45\frac{1}{2} \times 64$ ins.

The "L. & M." machine has been supplied to numerous firms in Great Britain and Ireland, Canada, India, New Zealand, Germany, Austria, France, Russia, Italy, and Switzerland.

FURNIVAL'S ROTARY.

This machine is applicable to both zinc and aluminium printing, and it has been re-constructed largely from the early pattern, so that it is simple in management and effective in production. As in all Furnival's machines the structure is substantial and fitted for long, hard usage.

The driving shaft runs across the machine, carrying pinions at both sides gearing into the plate cylinder, so that, like most British flat-bed machines the driving is double. Such driving is not the custom in Continental flat-bed machines, but in recent years the makers in Germany and elsewhere have fully

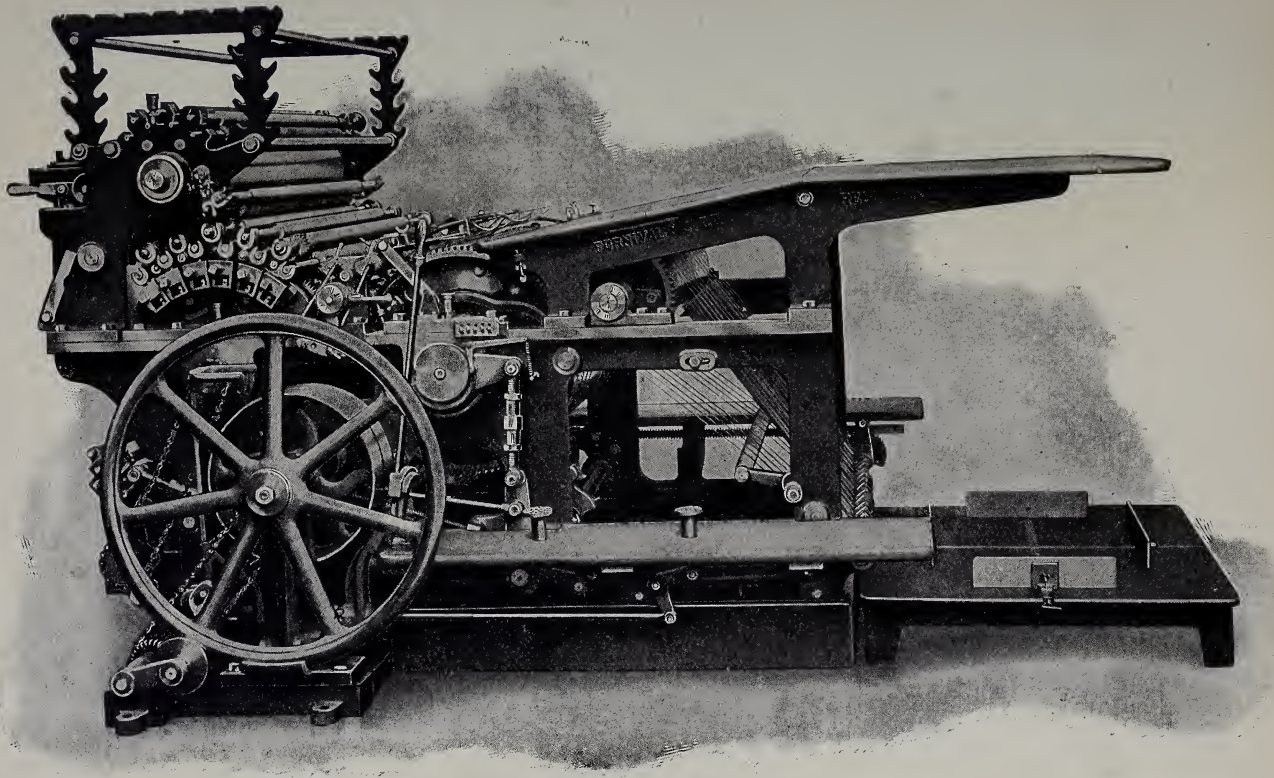


Plate Rotary of Furnival & Co. 1900-1909.

recognized the value of double driving, and have adopted it on the larger sizes.

The cylinders, after casting, are bored to receive a large shaft, then are turned on centre points, being finally ground up true not on centres, but running in their own bearings, as in the finished machine. The plate cylinder is partly occupied by an ink-distributing table. The printing plates are fixed by spring clamps at both the fixed edges, and by a simple arrangement in the gears the plates can be readily brought into register with preceding ones.

The impression cylinder (paper carrying cylinder) runs in eccentric bushes in the frame, for setting the impression and checking it. The adjustments obtained by this method allow the cylinder to be regulated to suit the varying thicknesses of the printing material—paper, card, &c. The feeder of the machine can press a foot lever, which gives a slight turn to the eccentrics and draws the printing cylinder away from the plate cylinder at any time, thereby checking the printing when necessary; and until the foot-lever is released the cylinders are not brought into contact. The gap in the impression cylinder is fitted with bridges, and the "off-side" of the cylinder is fitted grooves, on and in which the front lays ride, thus obviating the use of the steel underlays, so frequently the cause of paper creasing. The sheets are fed directly on the cylinder, and the lays can be adjusted to the finest possible measurement. The inking apparatus consists of the duct (ink box) with flexible steel blade (Docteur) to regulate the flow of the ink. The ink passes from the duct roller to a large geared reciprocating drum. The drum has above it the reciprocating distributors. From the drum the ink is taken by a roller having a rider, and transmitted to one rider of the inking rollers. The inking rollers may be four, six or eight, according to the size of machine. They can be taken out separately to lessen the inking capacity to suit different work. Each pair of inkers has one (polished steel) rider. The riders are all geared with the inkers, but when the inkers are actually rolling the plate the reciprocating motion of the riders ceases, thus preventing the possibility of side rub upon the work. The inking rollers are mounted in blocks which can be adjusted to the height and position of the printing plate; these blocks are struck with a surface of the same radius as the cylinder when they are made,

and can be moved along a slide for position in contact with the riders. The roller adjustments are such that the whole inking apparatus can be run independently of the cylinders, for running up the ink. They can then be brought to bear on the cylinder distributing plate for final distribution and evenness, before being brought into actual position for printing. The gearing of the machine is such that when the cylinder is checked, the inking rollers are lifted from the plate and double rolling is avoided.

The damping apparatus is of a well-considered type. There is a brass trough holding the water. In this trough is a slowly revolving brass roller which picks up the water—rubber pads are provided, which can be placed against any portion of this roller to diminish or cut off the supply. A duct roller takes the water from the trough roller and deposits it on a geared reciprocating brass roller which is in contact with the two damping rollers. The regulation of the supply of water is obtained by means of an ingenious cam which operates the duct roller. This cam slides on a key, and its different positions alter the "dwell" of the duct roller on the trough roller, so that if much water is required the duct roller is allowed to rest its full time on the trough roller; if less is required, then the machineman, by means of a convenient handle, moves the cam slightly, and so on into any position between the maximum and minimum.

The machine is also fitted with a slow turning motion. When the machine is stopped and the belt running on the loose pulley, the cylinders can be made to slowly revolve. The machineman is doing something at the plate, and wants the cylinder to move round a little; he presses a pedal, which is convenient to his foot, and when the cylinder has reached the desired position, he releases the pressure and it instantly stops. This is of very great convenience when putting the plate on.

The speed of this machine is only limited by the capacity of the feeder.

The sizes of the machine are four, from one which will print a design of 23×35 ins., up to 43×63 ins.

There are about 150 of these machines in use in various parts of Great Britain, Germany, France, Italy, Africa, and Australia.

GEORGE MANN & CO.'S ROTARY, OFF-SET ROTARY, AND PERFECTING OFF-SET ROTARY.

Specially contributed by MESSRS. G. MANN & CO.

The Rotary machine of the type for tin printing was shown at the Exhibition of 1904, and shortly afterwards (early 1905) a rotary for paper printing by direct contact between the paper and the printing surface was brought into the market.

The Mann Direct Rotary is notable for its small area and its high printing qualities, combined with simplicity. Much of the mechanism has been reduced to a minimum, only the really necessary parts being visible for adjustment purposes. The absence of complicated parts greatly facilitates the handling of the machine.

The feeder may, by using one pedal, check the impression cylinder, lift the inkers and throw the dampers out of contact with the plate.

The inking is arranged on Mann's special pyramid principle; the inkers and riders are large in diameter but as small in number as is consistent with efficiency and powerful rolling.

All rollers can be lifted clear of the machine for washing-up purposes, even the distributing drum; this is quite unique; no other rotary machine has this arrangement.

When the rollers are lifted, they are still kept in contact and in gear with the riders.

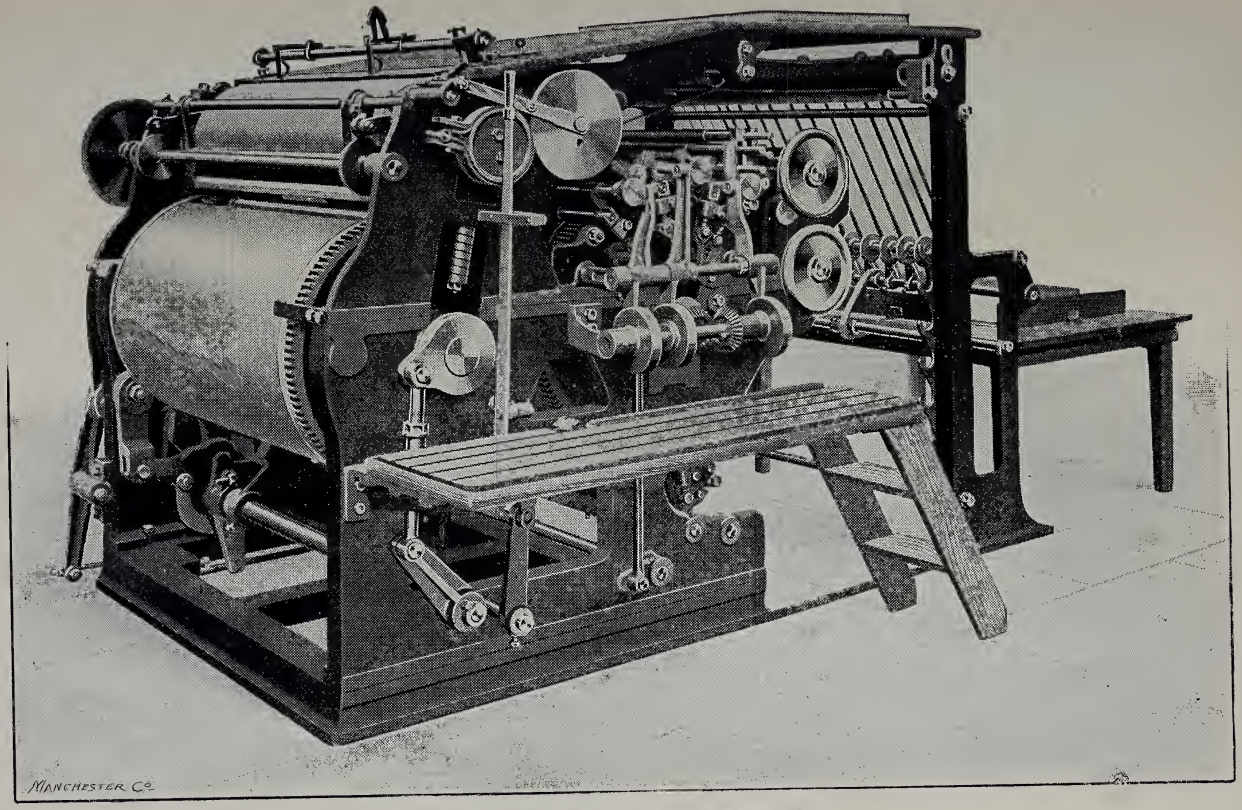
A separate lever is actuated for lifting the rollers when running up the ink previous to starting printing.

The damping apparatus is perfectly automatic, and can be adjusted to the very finest supply of moisture imaginable.

The front lays remain steady until the gripper holds the sheet. Fingers are unnecessary for holding the sheet, as the whole mechanism is automatic and rigid. The machine is fitted with Mann's Patent Brush, adjustable to give greater pressure at various sections, as a means of minimizing creasing and buckling of the sheets.

The machine has an automatic delivery, and knocking-up motion on the board.

These machines are made in six sizes, giving printing surfaces from 36×25 ins. to $64\frac{1}{2} \times 47\frac{1}{2}$ ins.



Off-set Perfecting Rotary of G. Mann & Co.

Off-set rotary.

The Off-set Rotary is really the outcome of Mann's Patent Rotary Tin Printing Machine, which was shown in the Exhibition of 1904.

As in the direct rotary, the printing is done from aluminium or zinc plates, clamped round a cylinder, which gives its impression to an intermediate cylinder, fitted with a rubber blanket; the sheet, which is carried by a gripper in a third cylinder, in turn receives its impression from the rubber blanket.

Perfect impressions can be taken on rough boards or embossed paper, as well as upon the general range of printing papers. In no case is it necessary to damp the paper, whilst an impression is given equal to die press work. The printed sheets are delivered face side up without being touched after receiving the impression.

In the off-set two colour and perfecting machine the plate cylinder has two distinct sets of inking and damping rollers, and two plates; the transfer cylinder has also two rubber blankets, consequently by allowing the third or impression cylinder to take an impression upon a rubber blanket stretched upon itself, the sheet is simultaneously printed back and front, or on the other hand, by allowing the grippers to hold the sheet for two revolutions two impressions are given on the face of the sheet.

This machine can be fed comfortably at 1,400 to 1,500 per hour.

The off-set principle effects a considerable saving in colour. Owing to the searching nature of the rubber, it is not necessary to use more than a thin film of colour to obtain a perfectly solid impression.

JOHN RATCLIFF & SONS' ROTARY.

The "Reliable" Rotary Litho.

The "Reliable" Rotary is of recent design, and has only been placed on the market during the last two years. No doubt experience of other makers has been well studied, and the result is possibly equal to any other make.

The whole framework is upon a solid and heavy bedplate. The frame is solid to give strength. The shafts are of thick steel.

The cylinders are turned and finished upon their own necks,

and the bearings are bored out in the frame in their actual working position.

The inking is effective, every roller having an independent adjustment. The inkers and distributors are the same size and are interchangeable. The axles of the rollers are long, for ready lifting out when required. When the cylinder is checked

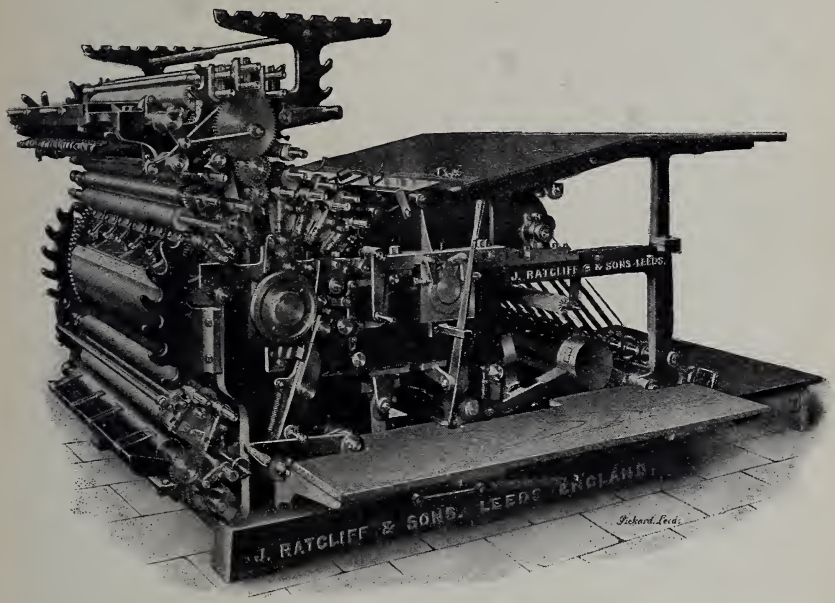


PLATE ROTARY OF J. RATCLIFF & SONS. 1907.

the inkers and dampers are moved from the printing surface, and if necessary the distributors may also be moved away from the drum. The inkers have a side adjustment with a set screw to hold them in any position. They can be set to the printing surface by screw adjustment, and without interfering with this setting they can be brought into proper contact with the riders.

When the cylinder is checked the inkers lift outwards and upwards, thus keeping in gear with the riders.

The damping apparatus is regulated by a fine screw adjustment which actuates the feed of the water to any degree. And the apparatus has two speeds to assist in fine regulation. The whole apparatus can be moved out of gear by hand, or is thrown out of gear when the cylinder is checked.

The feed guides lie in grooves in the cylinder, so that the sheets are fed into the cylinder. They can be regulated by screws. The gap is fitted with ridges so that the sheets may be fed without the steel underlays. The delivery is automatic, being adjustable for thick or thin paper, and the whole apparatus can be thrown out of action at any time.

The machine is fitted with a backing-up motion, which can be actuated when the machine is stopped, either from the front of the machine or from the feeder's stand.

These machines are built in three sizes with printing surfaces of 32 × 42 ins. up to 44 × 64 ins., and full enquiries as to any other particulars may be obtained from the makers at Wortley, Leeds, or their sole agents, Hunters Ltd., Poppin's Court, London, E.C.

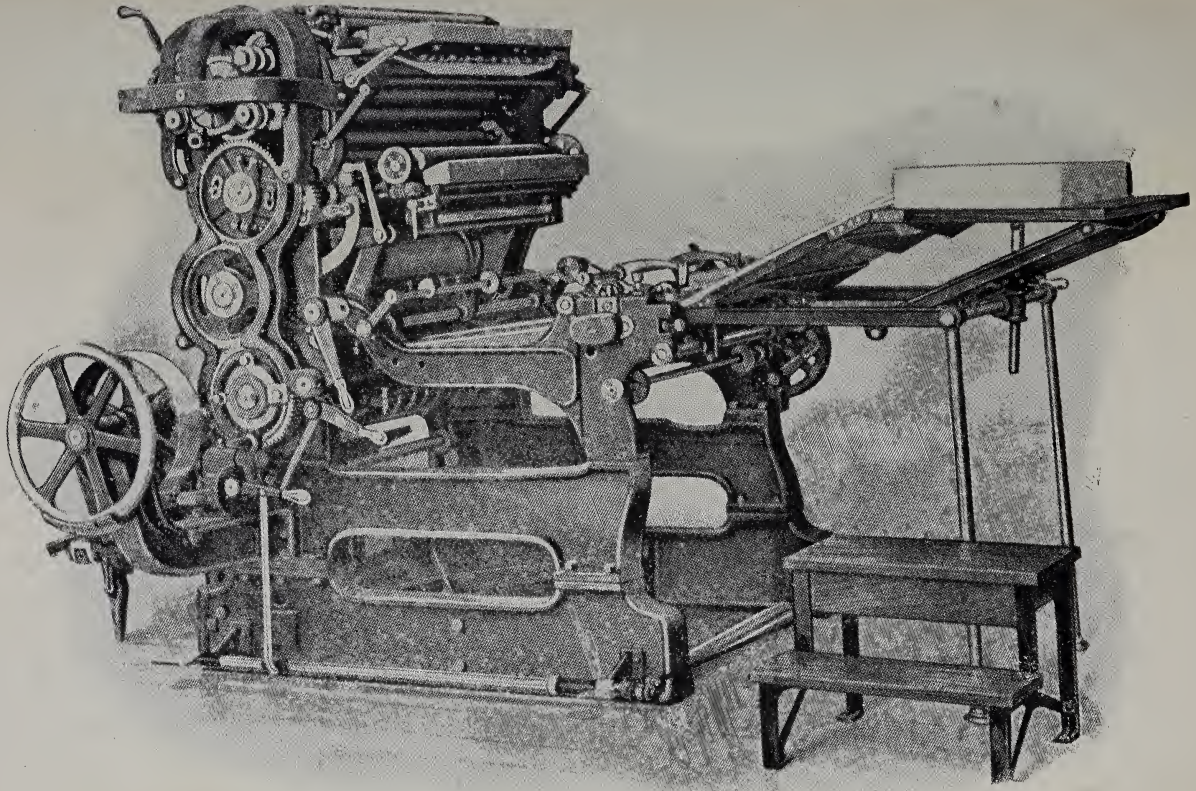
THE HARRIS AUTOMATIC ROTARY LITHOGRAPHIC OFF-SET PRESS.

Specially contributed by the

LANSTON MONOTYPE CORPORATION.

Since the introduction of lithography, like everything else this science has passed through various vicissitudes, but, until recent years, has proved to the modern lithographer too expensive and laborious an art to allow of great profits to be made out of the same, and under old conditions lithography has been gradually leaving England, and the English lithographic world in general has lamented the fact considerably, but been absolutely unable to stop the decrease of work hitherto enjoyed by them.

In the United States, lithography, through practically the same causes, gave way in great measure to letterpress work, and until recent years was also on the downward grade.



THE HARRIS OFF-SET ROTARY OF LANSTON MONOTYPE CORPORATION.

Experiments, however, and new machinery have brought new life and vigour into the lithographic world generally, and the inventive genius of the above press now enables both the British and American lithographer to make the most substantial and handsome profits out of contracts which under old conditions he would certainly have had to refuse, as he could not possibly have undertaken the work and performed the same in a satisfactory manner.

Lithography at 5,000 perfect impressions per hour sounds ridiculous, but, nevertheless, is an accomplished fact, and a fact which is being shown every day in the year by the Harris Automatic Rotary Lithographic Off-set Press. Both in England and the United States these presses are running, and have been now for some two years, and giving the most satisfactory results to the owners of the presses, and the most beautiful work to the press owner's customers.

The Harris Press, unlike any other machine of its sort on the market, is above all things most compact and perfect for the amount of work it turns out, as the floor space occupied by the double crown size is but 7 ft. × 10 ft. 8 ins. The machine can be either belt or power driven, and is constructed throughout of the best obtainable materials. All parts being numbered and machine-cut, they are at all times interchangeable.

The great feature of the press consists of the sheet feed which is attached, and which enables the pressman by simply placing upon the feed-board cut sheets of paper to run the press at 5,000 perfect impressions per hour without any further trouble, as it is so constructed as to give perfect register. The weight of paper is immaterial as the adjustments on the machine readily lend themselves to the variations in weight of paper. All sheets from 14 × 14 ins. up to 20 × 30 ins. can be worked satisfactorily on the press, and the *modus operandi* is as follows:—The machine is equipped with three cylinders, viz., plate, off-set and impression cylinders. The method of printing employed is that a zinc plate is attached to the plate cylinder over which run inkers and dampers; this cylinder transfers on to a rubber-covered cylinder, which, in turn, re-transfers on to the paper running between the off-set and the impression cylinders, which is then delivered. It will thus be seen that the cylinders being of the pyramid form, viz., one on top of the other, the operator has an unobstructed view of

the plate, rubber and impression cylinders, and of the sheets as delivered into the jogger. The importance of this upon a high speed press like the "Harris" cannot be over-rated, as in the event of any trouble arising, it can be checked instantaneously. The distribution of ink is effected by some twenty rollers, so that the same is absolutely perfect, and the mode of printing from thin zinc plates of $\frac{8}{1000}$ths of an inch thick, which are bent to the form of the plate cylinder, enables the user to obtain long runs of 120,000 impressions from the plate without harm; furthermore, this mode of lithography does away entirely with the troubles arising from veins in the stone which were such a continual bugbear to the antiquated system.

There is no doubt that lithography performed on the rotary rubber blanket off-set press will be the most popular mode in the future, and these presses are certainly bringing lithography back to its former standing. This press has been running on commercial work in England now for some two years, and in the case of one of our best known lithographic houses, has given such satisfactory results that they have already given the second repeat order.

There has just been perfected a smaller size Harris machine taking crown size sheets, and working on exactly the same principle as the one under discussion. All interested in the press should apply to the Lanston Monotype Corporation (Printers' Machinery Department), 43 and 43a Fetter Lane, E.C.

R. HOE & CO'S ROTARY MACHINES.

Specially contributed by MESSRS. R. HOE & CO.

R. Hoe & Co. were amongst the earliest makers of rotaries. They state that as early as 1884 rotaries were made at their works. The enormous newspaper rotaries of all types made by this firm are well known for their accuracy and stability of manufacture, and the same characteristics may be found in all their makes of planographic rotaries. The earliest rotary recorded in the British Patent Office by this firm was made by R. M. Hoe in 1870, and from 1899 some eight or nine other patents relating to rotaries have been registered. The rotaries made by them are the ordinary single form with two-colour and three-colour machines, their latest type being the off-set rotary.

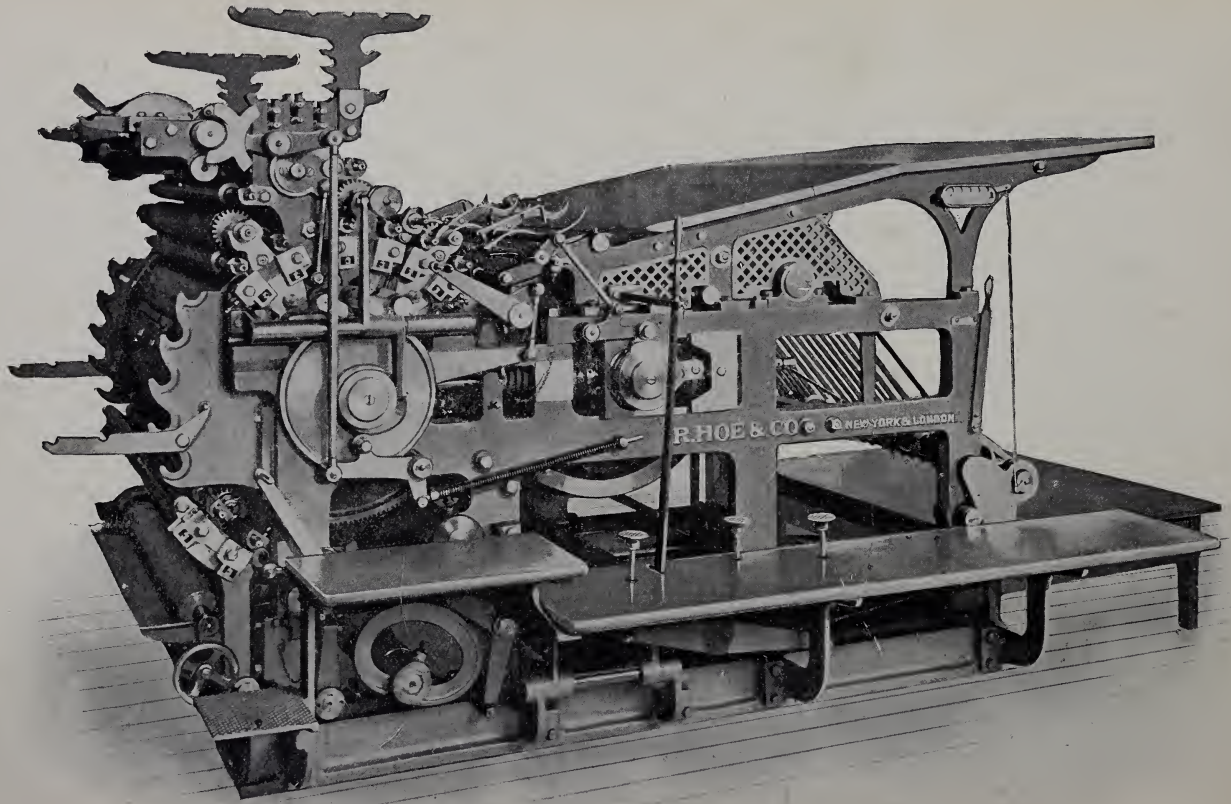


Plate Rotary of R. Hoe & Co.

R. HOE & CO.'S SINGLE COLOUR ROTARY ALUMINIUM PRESS.

The cylinders are of the same size; the plate clamps are the subject of a patent. When the clamps are loosened the jaws remain open to receive the plate, enabling the pressman to hold the plate with both hands when putting it in the clamps. The tightening-up is done with winged nuts, a method for which it is claimed that greater accuracy is obtained, owing to the unique construction of the jaws: the plate is gripped more securely by means of these winged nuts than by screws tightened by spanners as in the ordinary clamps.

When fresh ink is put in the fountain, the rollers set, and the machine run to work up the ink, the rollers are automatically lifted to clear the printing plate as it passes under them and brought down upon the inking surface in each revolution of the press. In this way the ink is thoroughly worked up until there is sufficient ink on the rollers and the inking surface before any is applied to the printing plate.

The damping apparatus is of the modern style, being upon hinged frames, readily put in or out of action by separate lever or when the cylinder is checked. The regulation of water supply is as now constructed with the off-set machine. In fact all the most recent improvements in this machine are the same as on the two-colour, three-colour and off-set machines. Machines are made to print designs from 29 × 43 ins. to 43 × 63 ins. and the weight is from 21,000 lbs. to 31,000 lbs.

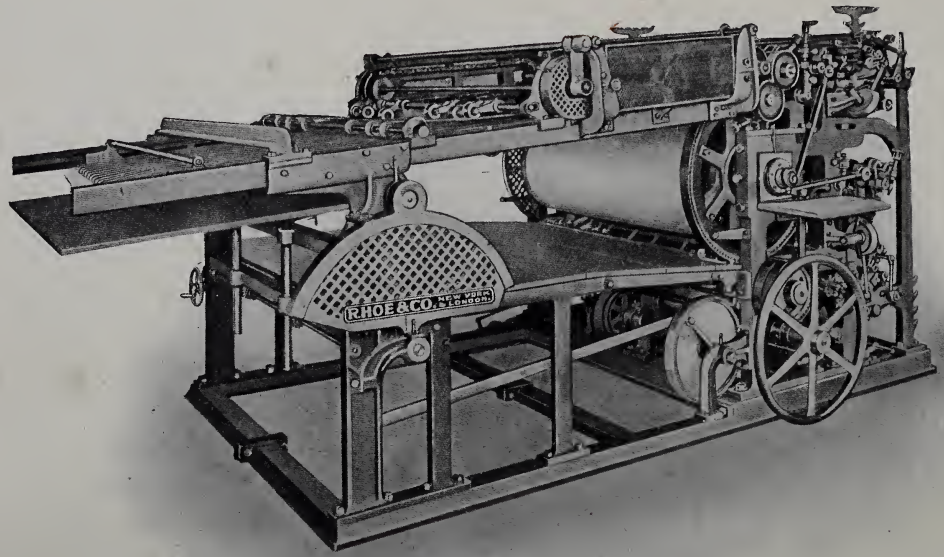
R. HOE & CO.'S TWO-COLOUR ROTARY ALUMINIUM PRESS.

Maximum sheet 44 × 64 ins.

One large impression cylinder and two plate cylinders. The sheets are fed to the under-side of the impression cylinder, printed side down and are delivered from the upper side of the cylinder printed side up, nothing coming in contact with the printed surface while being delivered.

The plates are inked by four rollers carried in frames, which can be swung away from the cylinders for ease in placing and removing the rollers. The plate cylinders make two revolutions for each impression and the plates therefore are inked twice.

The impression cylinder can be tripped by the feeder. The delivery board is arranged so that it can be lowered as the



New Two-Colour Rotary of R. Hoe & Co.

height of the pile of sheets increases, and can be quickly raised when the pile is taken off.

The motor for driving is placed underneath the feedboard, driving by belt with a pulley on the driving shaft. A 7½ h.p. motor is required, although it does not take quite so much power as this.

Floor space occupied, 15 ft. 5 ins. × 9 ft. 5½ ins. Height 7 ft. 3 ins. Net weight about 26,000 lbs.

This press is also made with front delivery, to take a plate 36 × 46 ins., design 33 × 46 ins. The press needs a 5 h.p. motor.

Gross weight 20,000 lbs. Net weight 17,000 lbs.

These presses can be equipped with slitters to slit the large sheets into four narrow sheets.

R. HOE & CO.'S THREE-COLOUR ROTARY ALUMINIUM PRESS.

Prints a sheet maximum size 44 × 64 ins.

Four forme rollers are provided on each plate cylinder, and as these cylinders make three revolutions to one printing, give an equivalent of twelve forme ink rollers. The colour is thoroughly distributed before being applied to forme rollers.

The water dampening movement is adjustable by hand-wheel from maximum to minimum supply.

The feeder stands upon the floor, instead of on elevated platform, and thereby has greater freedom and control of press.

Feed motion (improved) gives perfect register.

The cylinder is tripped at any time, automatically, by a foot treadle, requiring only slight pressure of the foot to actuate it.

The patent front delivery takes the printed sheet and deposits it, printed side up, on delivery table, and no tapes or surfaces whatever can come in contact with print.

The delivery table is adjustable in height.

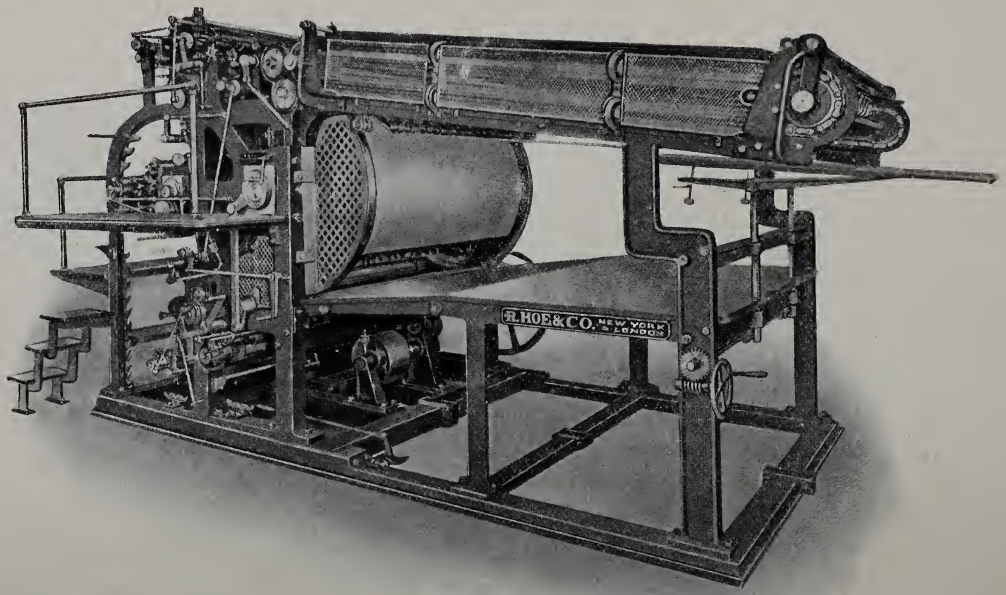
Weight approximately 32,000 lbs.

R. HOE & CO.'S ROTARY OFF-SET PRESS.

Sheet-taking Device. This is noiseless and holds the sheet in a fixed position under control until it is entirely printed.

Delivery. This is printed-side-up in view of the operator. Sheet jogger is provided.

Ink Distribution. This consists of a large central ink drum and four smaller vibrating drums, two of which vibrate over the



THREE-COLOUR ROTARY OF R. HOE & CO.

four forme rollers and hold them locked in positive contact with the plates. All the ink rollers are securely held in position when set, and all adjustments of rollers and fountain easily accessible from the floor. The ink supply is automatically checked when the press is tripped, thus ensuring an even colour in all impressions, preventing a thickening of the design upon the plate, so that all impressions will be uniform in appearance.

The Inking Rollers are mounted on swinging arms and are so arranged in connection with the water forme rollers that it is impossible to place them in contact with the plate until the water forme rollers have first been placed in contact with the plate to dampen it. This prevents spoiling the plate by accidentally inking it in dry. The ink fountain is furnished with removable back for greater facility in cleaning.

The Water Motion is described as the finest that has ever been put in a rotary press: more sensitive and easy to adjust than any damping device hitherto employed. The two water forme rollers are held in locked sockets in a positive contact with the plate at any pressure found desirable, and are connected with the ink forme rollers in such a way that they must first be placed in contact with the plate. The water riding roller vibrates, ensuring an even distribution of the water. The water fountain roller is gear-driven and so arranged that it can be easily removed for covering with muslin or for cleaning purposes. The water fountain is arranged so that the water can be run off when found necessary to change it.

All distributing rollers and cylinders are positively gear-driven and are not removed from gear contact when the ink and water forme rollers are lifted from the plate.

The Cylinders are of especially strong construction, balanced and ground absolutely true, and run on forged steel journals in special hard brass bearings. The cylinder gearing is furnished with back-lash rims, which prevent any play or slip and ensure the cylinders working in proper unison. The gear on the plate cylinder is arranged so that the lay of the design can easily be changed to suit register of sheets requiring more than one impression, or for any other purpose.

The Plate Cylinder is furnished with special patented plate clamps, which hold the plate taut and allow no slipping or moving under pressure.

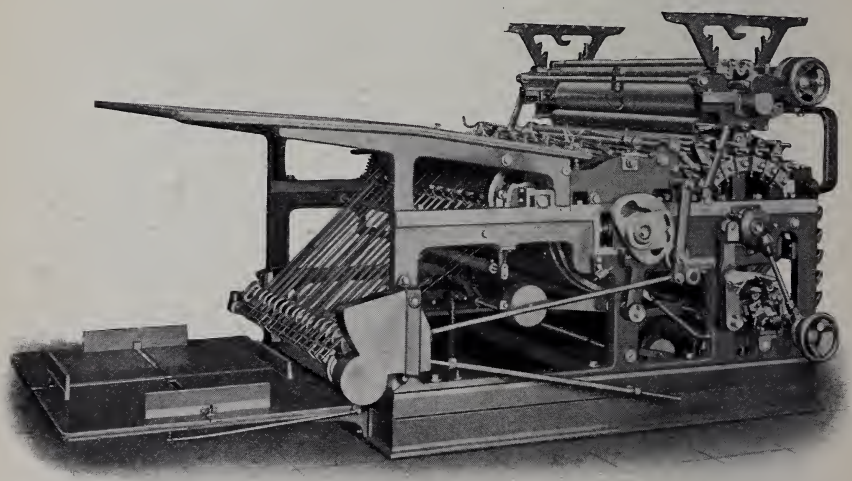
The Rubber Cylinder is furnished with substantial clamps and reel for holding blanket and stretching it to the proper tension for printing.

An Automatic Trip is provided, which prevents the sheets being spoiled by partial impressions, which are unavoidable on hand-tripped presses.

The whole machine is strong and substantial, designed so as to be handy, accessible for adjustment and cleaning, and is simple in operation.

"BAVARIA" METALOGRAPHIC ROTARY.

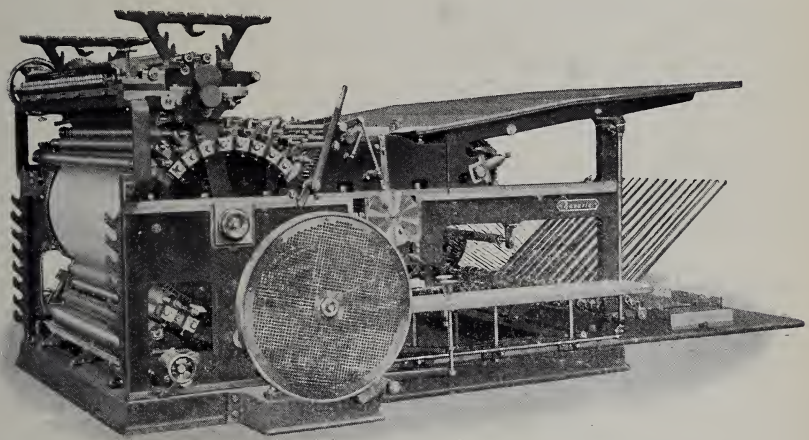
The "Bavaria" Rotary is made by Albert & Co., Frankenthal, Bavaria. This firm claims to be the largest printing machinery manufacturers in Europe. The Rotary is of the now well known, carefully manufactured style common to German manufacture. It is strong and rigid throughout: the gearing is upon an improved patent, and with the wheels being accurately cut, a silent and smooth running is obtained. This feature is quite



noticeable when visiting German printing firms, and is a contrast to many of the noisy British printing offices.

The plate and impression cylinders are placed horizontally in contact, and are of the same size.

The duct roller of the inking apparatus is in continuous rotation, or can be stopped, if required. The amount of ink taken up by the vibrator can be regulated by means of a conical eccentric to a nicety down to zero. The vibrator imparts the



ink to the large distributing cylinder on which the ink, by the waving motion of this cylinder in conjunction with the distributing rollers and riders, is most evenly distributed.

The two transfer rollers are in bearings with springs by which they are kept uniformly in firm touch with the distributing cylinder and rollers, so that the transfer of the ink is ensured in a perfectly uniform manner. The projecting spindles of the inking rollers take the form of handles by means of which the rollers can be easily placed into position or taken out.

Provision is made that the inking rollers can be raised from the plate and the inking apparatus can run alone in order to

have the ink thoroughly distributed before commencing printing, whilst the plate and impression cylinders, damping apparatus, delivery, &c., are at a standstill.

The rotating water roller takes the water from the water trough and gives it up to the vibrating roller which imparts it to the distributing roller. The two damping rollers take the moisture from the latter and damp the plate uniformly.

For good printing the proper damping of the plate is as essential as the proper inking. The damping apparatus possesses a two-fold regulation that permits the increasing or decreasing or stopping of the moistening of the plate in a convenient manner while the machine is running.

That part of the plate cylinder which is not covered by the plate is utilized as an ink table. A large number of plate-holders with tightening screws render possible an even fastening of the plates, and the upper clamps which keep automatically open permit of the plates being easily placed in or taken out.

The access to the plate is very convenient, the front part of the cylinder being left entirely free. The washing out and making ready of the plate are not hampered by the inking apparatus.

The impression cylinder can be put back by means of a treadle and the impression thrown off so that sheets may be saved if inaccurately laid on. The front and side gauges are adjustable, to facilitate the register.

The fastening arrangement of the plates permits a sliding of the plates backwards or forwards.

The gripper closing mechanism is provided with a safety device of such nature that the mechanism will not suffer damage should the grippers, when making ready, be left open.

The "Bavaria" Rotary is supplied either with flyer or carriage delivery, the latter resembling that on two-revolution presses.

With the flyer delivery the printed sheet is taken over a gripper drum to the flyers, which lay the sheets, printed side up, on the delivery table, which has a sheet jogger acting from four sides.

With the carriage delivery a gripper turning drum is arranged close to the impression cylinder, which carries the sheet so far out till it can be laid down on the carriage which takes it, printed side up, to the delivery table. The turning drum has the same diameter as the impression cylinder. The delivery

table is so arranged that it is lowered automatically in the same proportion as the pile of printed sheets increases.

By this method a careful delivery of the sheets is assured and the printed sheets on the elevated table can be examined more conveniently and thoroughly than with the flyer delivery.

The speed is, according to the size of the machine and quality of work, from 1,400 to 2,400 sheets per hour.

The "Bavaria" is successfully used in Germany and other countries.

CHAPTER XIX.

Rotary Planographic Printing Machines.

THE evolution of the rotary printing surface for lithography—and subsequently for metallography—had its origin in Senefelder's brain, if such an inference may be drawn from the words, "For the purpose of drawing on a stone-plate or cylinder I have invented a peculiar machine," in the footnote of page 336 of "Senefelder's Complete Course of Lithography," 1819. It was not until twenty-three years later that De Troisbrioux, of London, invented a machine with rollers of litho stone or metal plate, with damping and inking apparatus driven by contact with the cylinder. He went so far as to have the machine duplicated with tapes for carrying the paper to be printed on the other side. In 1844 Baldermus, of Berlin, consummated the rotary by adding an automatic feed. The next year George Scholefield, of Manchester, still further improved the machine, by making a more compact and serviceable damper. And the feeding of the sheets was upon an endless "tympan" cloth, and delivered in a receptacle. In 1854 J. Wallace, junr., of Glasgow, made a rotary hand press, in which he introduced damping by a saturated roller, and a pad to follow the damping to remove the surplus moisture. This latter device was revived in Morriss's patent 24,944, *1899,* in which a roller was used for the same purpose. Wallace also added an eccentric motion to move the damping apparatus out of contact with the plate. In 1855 a foreigner constructed the printing cylinder of segments of stone on a cylinder of iron. He also used zinc as the printing surface on an iron cylinder. In another foreign machine of the same year was introduced a travelling inking table, receiving ink from vibrator and duct, and giving its ink to a roller which was in contact vertically with other rollers ; thus the ink was fed upwards to the printing cylinder, above which was the impression cylinder.

It is noticeable throughout the thirty-one presses and machines invented from 1801 to 1857 that "zincographic"

printing was almost invariably coupled with "lithographic" printing, and that many of the inventors made a strong feature of their machines being applicable to printing on fabric, generally in a continuous web. It might also be noted that having once used a tympan in a press, seemed to compel every inventor to introduce a tympan in the machine, which was generally a serious engineering device. Few, if any, of them could see how to abolish it.

In 1863 Warssam, of London, introduced a machine in which both cylinders carried printing surfaces, to print both sides of the paper at once. Three years later J. Marr, of Glasgow, used springs to the inkers, and levers, weights or springs to the damping flannel to secure their pressure on the printing surface. He, however, arranged his machine with separate sets of complete printing surfaces and produced several colours successively. This might be considered as the earliest *multi-colour rotary*. In 1869 W. MacLean, of Glasgow, added improvements as to pressure cylinders, inking and damping apparatus.

In 1870 the making of rotaries passed into another stage of development. C. Parker, of Meriden, U.S.A., made a machine in which the printing cylinder carried a flat stone, an inking table and damping board. The impression cylinder was half the diameter of the other, and was fitted with grippers to take the sheets; whilst an automatic delivery was effected. In the same year J. Lewis, of Dublin, made a rotary called the Drum machine, in which the stone was ground convex. The paper was fed to lay guides, and a flying tympan operated at each impression. He used one or two rollers not carrying ink, to traverse the stone after inking to clear the work. He also invented a machine for grinding the stones convex. Later in the same year, R. M. Hoe, of New York, made a machine similar in principle to Lewis', having a curved printing surface on the stone. In 1871 Simmons, Simmons & Smith, of London, made a double rotary to print both sides of the paper at once, each cylinder having complete inking and damping apparatus, very similar to Warssam's machine of 1863. Greig & Greig, of Edinburgh, later in 1871 made a rotary, using a flat stone recessed in the cylinder, and with an impression cylinder covered with an elastic substance, whilst in 1872 R. M. Hoe improved the 1870 machine to carry several stones side by side

on the cylinder. It was also in 1872 that P. Wolstenholme, of Blackburn, made a machine with stone on the cylinder, but his special points were to place an elastic bedding under the stone, and elastic packing between the pressure screw and the bearings of the impression cylinder. He arranged for some inkers to oscillate. In his patent he also claimed seamless coverings for rollers.

The machine is one of remarkable interest. In its early form it was driven by hand. The flywheel was turned first one way and then back again, to secure double inking. Even when geared up for greater speed some years later, no feeding gauge or adjustment was added, and in feeding it was no uncommon thing to have to check, owing to bad feeding. Still later the machine was re-constructed for power driving with delivery apparatus, and such machine is actually in use at the present day. The work being done is first-class note headings, of which "The Printer's Speciality Co., of Blackburn" headings are a fair sample.

The cylinder is little more than half a cylinder, the part cut away forming the bed for the stone. The cylinder carries an inking table, and both inking and damping apparatus are at the top of the cylinder. The impression cylinder, about 3″ diameter, is below the printing cylinder, having an endless blanket running to carry the paper. It is only a small machine, as the largest stone used is but 10 × 5 ins. Even this machine gave 1,600 impressions per hour. During quite recent times (1907-8) there were considerable improvements in the feeding and other parts devised, and it is yet possible that small machines of this simple type will be made with self-feed and automatic delivery.

Nothing of any importance was introduced in the succeeding seven years, except the early form of bedplate for zinc plates in flat-bed machines, by Borrett & Hyde in 1875. In 1879, Butterfield, Harper & Scott, of London, made a rotary in which both impression and printing cylinders were made of stone, or carried zinc plate. In the same year Schlotke & Hesse, of Hamburg, made a rotary of a simple form to print both sides of the paper; and Flürscheim of Gaggenau made a little (office) rotary with stone or composition roller.

Woodhouse, of London, used zinc on the damping board to pick up dirt from the rollers in 1880. Again in 1881 Schlotke &

Hesse made a machine with both cylinders to carry printing surfaces similar to Warssam's (1863), Simmons & Smith's (1871) and Butterfield's (1875), and it was of a good construction. In the same year and the next, Hopkins, Baker and Burt, of Birmingham, introduced a rudimentary tinplate printing machine with the vulcanized rubber off-set cylinder. This appears to be the commencement of *Off-set Machines.*

In 1882 Kraÿer, of Klein, Forst & Bohn, Johannisburg, Germany, made a multi-colour rotary with a series of printing rollers around a large cylinder, the printing rollers having zinc plates on them. And in the same year Hayward, of London, made a rotary with stone cylinder, or iron cylinder covered with zinc plate working above the impression cylinder. Pollak's (London) multi-colour rotary of 1883 was made for letterpress, but though stated to be applicable to lithographic printing was not well suited for it. It was in 1884 that Marinoni & Michaud, of Paris, made an off-set machine, suitable for printing two or more colours at the same time.

In the same year Pollard, of Geo. Mann & Co., Leeds, made a rotary with zinc on the cylinder, bearing upon a travelling impression "bed." This rotary was intended for public inspection at the Inventions Exhibition, but circumstances occurred which prevented its being erected there. The next year C. & E. Layton, of London, introduced the first of the modern zinc-plate beds for flat-bed machines. It was in this year, too, that the same firm introduced the "litho plates" patented in 1883 and 1884 by Möller.

From this date it may be stated that the experimental stages of rotary building had nearly been completed, for, after the attempts of Kocher in France in 1867, and of Guillot in 1877, who had two rotaries in the Ministry of War in Paris, the firm of Marinoni in Paris made the "Diligent" machine in 1886, exhibited in the 1889 Paris Exhibition, and worked at Liege Exhibition in 1906.

One of Marinoni's machines went to Helfmann, of Valparaiso, in April, 1890, and has worked there successfully to the present day. However, although the French engineers had practically made a machine in 1886, it must be recorded that in England T. R. Johnson, of Edinburgh, constructed an excellent type of rotary in 1886 also. The printing cylinder was large and carried the zinc plate, as well as inking table and damping

surface. The impression cylinder was about half the diameter of the other, and was mounted obliquely above it. In fact it was the same type as the machines of about 1897-9. Still, however, curious types of rotaries were made, such as that of Parrizy, of Paris, in 1887, which had two rolls of paper at the top, each being fed down to separate rotary printing cylinders on each side of the machine. In 1887 T. Reiner, of Leipzig, made a mangle-like rotary, in which the printing surface was a composition of soluble glass, whiting, glycerine, oxalic acid, magnesium chloride, manganese ore and mineral colour; and in 1888 Ainsworth, of Accrington, made another on the mangle type, for two or more colours. Of the succeeding inventions Forbes, of Boston, in 1889 introduced plate grippers in a recess in the cylinder. Blackwell & Blacklock, of Reading and London, followed in the same year with cylinder of stone, &c., in a machine like Reiner's and Ainsworth's; and MacPhail & Cahill, of Manchester, made another multi-colour machine with a number of printing cylinders of stone or composition working round a large impression cylinder. Auguste-Godchaux, of Paris, made a similar machine, adaptable for stone, zinc, copperplate or type metal printing surfaces in 1891. M. Wright, of Leicester, in 1891 showed an ingenious method of clamping the plates on the cylinders in small (stencil) rotaries.

It was in 1892 that J. McAleese, of Glasgow, produced a good working model of a zinc plate rotary. It contained all the elements of a successful machine, in fact, it was probably the forerunner of the succeeding types of machines, coupled with the principles of Johnston's machine of 1886.

In the same year Michaud, of Paris, made another off-set machine for printing both sides of the paper at one impression.

Later in the year (1892) Pollard & Brayshaw, of Leeds, made a tinplate printing machine, using an off-set or transfer roller; but Rusby, of Leeds, adapted flat-bed machines with an off-set roller in 1894, which appears to have become the recognized type for such machines.

As, at this time, rotaries were being spoken of very considerably, it might be well to trace another course of the rotary machine which commenced with W. Bullock in America, followed by the stone cylinder machines of the Parker Arms Co., of Meriden, between 1860 and 1870. When Möller's zinc plates were introduced in 1884-5, a rotary machine was made in

America by the Huber Printing Press Co., and in 1886 they installed a machine with the Forbes Lithographic Co. Before 1891 some thirty such machines had been introduced into printing works, including the Providence Lithographic Company. Notwithstanding that the Huber rotary was more or less known in England, it appears that the only one installed in England was at Nottingham. From there it was purchased and taken to Leeds, where it was considerably altered and improved. At this period aluminium was definitely introduced to the trade by Bullock & Mullaly in their patents 15,238, *1891,* and 10,781, *1892,* which induced them to seek to have a rotary specially built by the Huber Co., with whom, however, negotiations failed, and a separate company was formed to make a rotary. It was not until 1897 that this new company registered any patent in England. In that year, under the name of the Cornwall Printing Press Co., of New York, a rotary was patented, having both cylinders the same size and the impression cylinder capable of being moved out of printing contact with the printing cylinder. It was the early type of the modern American rotary, afterwards sold by the Aluminium Plate & Press Co., as the Alumographic machine. In 1897 the name of "Cornwall" was given, in consequence of the association of Mr. G. R. Cornwall with the Company, of which some other members were, apparently, Mr. G. Wishart (who was known in London in connection with the Aluminium Press Co.), Mr. Nathan Parker and Mr. Bicknell Hall (a draughtsman from the Huber Rotary Co.). It may be remembered that the Aluminium Press Co. was sold to the "Trinity Corporation," early in 1908, for $27,000. In 1901 rotaries were being manufactured in America by the Huber Co., R. Hoe & Co., Aluminium Plate & Press Co. and Walter Scott; and the Hoe Co., it is stated, commenced building rotaries as early as 1884.

Concurrently with the 1891-92 efforts in America, it may be mentioned that T. Ruddiman Johnston, of Edinburgh and London, made great improvements in 1895 upon his machine of 1886. He improved both inking and damping apparatus, and introduced feeding apparatus. In the same year the Maschinenfabrik Johannisberg, Klein, Forst & Bohn, of Geisenheim-on-Rhine, made a rotary in which the impression cylinder was two-thirds the size of the printing cylinder: and whilst the

plate cylinder revolved twice for double inking, the impression cylinder revolved three times, taking the impression at the third revolution. In 1896 Thornton, of Altrincham, made a species of rotary for printing direct upon stiff card, metal, wood, &c., and in the same year Rochester & La Ronde, of Ottawa, Canada, made a multi-colour rotary for printing fabrics specially, although applicable to paper printing. Julius Wezel, of Leipzig, followed shortly with a rotary in which the printing cylinder revolved first one way and then the other, and, having two impression cylinders, produced two impressions in one traverse of the machine. In 1897, besides the T. R. Johnston rotary already mentioned, B. Hall, then in London, made a rotary with both cylinders the same size, in which the printing or plate cylinder could be moved out of contact with the impression cylinder or the inkers. The dampers were on a separate frame and could be thrown out of contact, just as was done by J. Wallace, junr., in 1854. In 1899 Koch, of Leipzig-Connewitz, made a machine apparently on the same lines as that of J. Wezel in 1896; Koch and Wezel combined their efforts in producing a tumbler rotary machine, which worked very well, and was visited in its German home by good judges of machines, but some legal differences arose which caused the cessation of their construction. In the same year, Bohn, of Wurzburg made a machine like a Wharfedale letterpress machine, the printing cylinder above, and a small impression cylinder below, revolving only at the time when the impression was taken. He added an automatic feeder to feed into grippers, and a delivery apparatus giving a positive delivery. It seems that this form of machine, probably containing the principles of the earlier machine of Klein, Forst & Bohn (1895) with the later improvements, became known in England in March, 1900, as the Bohn & Herber, "Algraphia" rotary, of Wurzburg, which was said to have been in use for some years at the works of Mr. Josh Scholz in Mainz, and the patents of which were acquired by an English company, but no machines of this type were built in England. The year 1899 was full of improvements in rotaries. The Aluminium Plate & Press Co., of New York, brought out a much-improved machine, in which the inkers could be thrown out of action and run up in ink separately. Oscillating inkers were added. Damping apparatus was improved, and made capable of very fine regulation in supply, and

an automatic delivery was attached. This machine, with but little improvement, was the latest type made by this company, and in 1901 some 120 of their machines were in use. This number was considerably increased in later years.

R. Hoe & Co., of New York, made a machine, with fine adjustments for slowing down the impression cylinder at the end of taking the impression, and re-starting at an accelerated speed, and an automatic delivery attached. In the year 1899 this company introduced a two-colour rotary, with two plate cylinders and one impression cylinder. Still later J. S. Morriss, of London, added a damp-collecting roller to traverse the plate after damping, as already introduced by J. Wallace, junr., in 1854.

It was in 1900 that Furnival's, of Reddish, made their rotary with small impression cylinder, to stop between each impression. The inkers could be thrown out of contact for running up. The impression cylinder could be thrown out of contact. This type, known as Furnival's rotary, was, with little improvement, put upon the market and exhibited along with the Linotype Co.'s Rotary, Aluminium Plate & Press Rotary and Mann's Tinplate Rotary at the Printers' Exhibition of 1904. This mention of the Linotype Company's Rotary brings into prominence a machine which had then only just been perfected to its then condition, and may be looked upon as the latest comer in the ordinary type of rotary machine.

Amongst the crop of machines brought out in 1899 may be mentioned a multi-colour machine by the American Lithographic Co., in which they specially made a press for transferring the designs on the separate rollers. Some one to ten such rollers were mounted around one central impression cylinder.

Of the machines introduced in 1901 by Gebler & Schmidt, in Germany, E. Lee, of Leeds, L. Petuel, of Munich-Reisenfeld, and J. A. Horne, of London, little need be said beyond their mention. But it was about this period, or rather earlier, that Walter Scott made rotaries in America, and Faber & Schleicher in Offenbach, both of them being of the modern type. Bicknell Hall, formerly the draughtsman at the Huber Press Co., introduced the Algraphy machine of the simple type, with the gearing all well within the framework, and all the adjustments for throwing the impression cylinder, inkers and dampers out of contact.

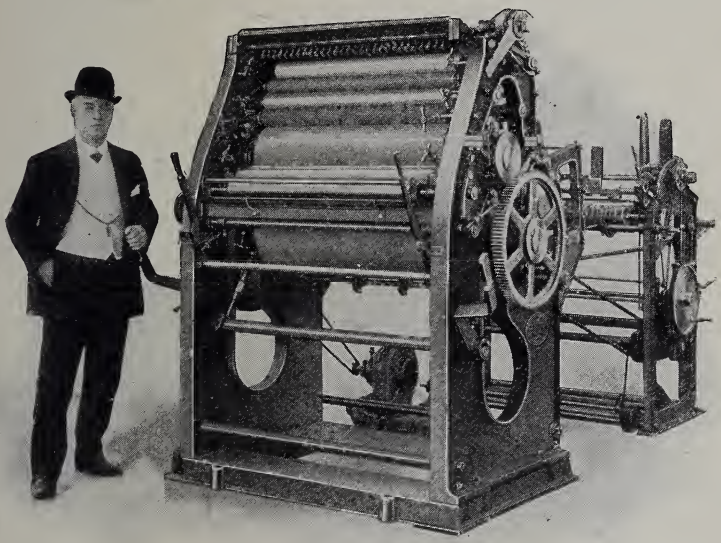
In 1901 R. Hoe & Co. made a four-colour rotary with two large printing cylinders to carry two plates each, and three other cylinders to be used as two impression cylinders and a carrier, so that the sheets could be fed four times in quick succession. The success which this machine had in America is well known.

In 1902 R. Hoe & Co made an off-set rotary, in which the off-set rubber-covered roller received its design at one revolution and printed it on paper or metal at a second revolution, thus reviving the off-set machines of Hopkins, Baker & Burt made in 1881, and Marinoni in 1884. R. Hoe & Co. improved their inking apparatus, and in 1903 made similar improvements in the damping apparatus, by throwing them out of contact when required.

In 1903 the Aluminium Press Co. made the printing cylinder to move out of contact by eccentric bearings, and in the same year the Linotype Co. improved their rotary by making the checking of the impression cylinder also actuate the gear by throwing the inkers out of contact. It was in that year that the Geo. Mann Tinplate Rotary was introduced, and the same firm made the sectional brush. In the following year J. White, of New Jersey, U.S.A., made an off-set rotary machine with a reciprocating transfer roller to take its impression and then move to the impression cylinder. In the same year Walter Scott, of Plainfield, U.S.A., made a three-colour rotary machine, with several pairs of cylinders acting successively.

In 1903 the Linotype Company's Rotary was much improved; whilst Rogers, of New York, introduced a machine with a printing cylinder above and an off-set cylinder below, so that in passing paper between the two it was printed on both sides. In 1905 the Mann Rotary for printing on paper was fully developed, and the special movement of the inkers up and round the riders was adopted when checking the cylinder and inkers simultaneously. The same company also adopted gearing for throwing the printing rollers of a multi-colour machine out of contact, as well as using rollers, runners or balls in the various bearings to minimize friction. During the same year the Linotype Co., in England, improved the side lay and delivery apparatus, whilst G. R. Cornwall, of Rye, U.S.A., introduced an electric attachment which stopped the cylinders in the event of no paper being carried for printing.

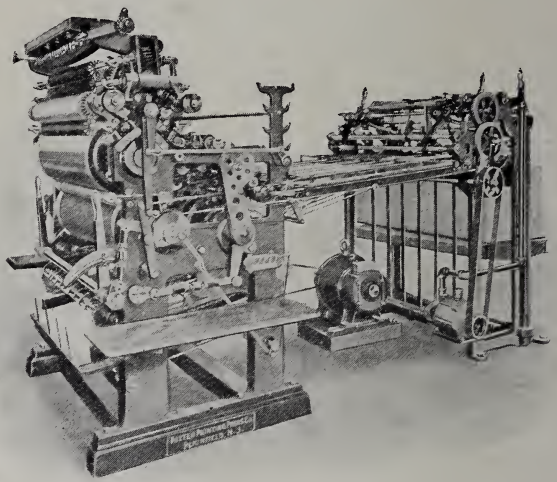
In 1906 the late Ira Washington Rubel introduced into England the off-set rotary of the more modern type. He had already made the machine and worked it in America, and he may undoubtedly be awarded the claim for introducing the New Rubber Off-set machine to the printing world, notwithstanding that Rogers, in 1904, made something apparently similar. This machine appeared in an improved form in the



Off-set Rotary of Ira W. Rubel. 1906-8.
(By permission of A. Penrose & Co.)

Potter Off-set machine, from their works at Plainfield, U.S.A. The Rubel was mentioned in Penrose's Annual, 1906-7, and early in 1907 the Sherwood Litho Co., Chicago, and Goes Company, Chicago, had installed Potter Off-set Rotaries. In less than a year these rotaries were installed in numerous houses, three machines being in New York and twelve elsewhere, including one with the Gugler Litho Co., Milwaukee.

In May, 1907, there was some mention of the Harris Off-set Rotary, and in 1907 the same machine had been worked at 5,000 runs per hour. It was not long after that a Harris Off-set was installed in London, and gave most satisfactory results, since which similar rotaries have been placed in another London house. Fuchs & Lang made an off-set rotary just prior to 1908, and sold the first machine to W. F. Powers, New York, early in 1908. Although in July, 1908, the only types of rotaries in America were reported to be the Potter, Harris, and Fuchs &



THE POTTER OFF-SET ROTARY.
(By permission of A. Penrose & Co.)

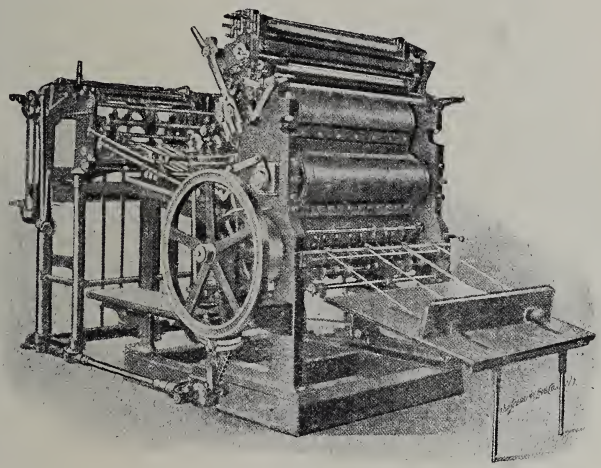
Lang's, yet Hoe & Co. installed an off-set rotary in the Government printing office of Montreal at about the same period.

In 1906 the Schnellpressenfabrik Aktien Gesselchaft, of Reutzschmuhle, made an off-set rotary, with double sets of rollers, to print both sides of the paper.

In the same year A. B. Sherwood, of Chicago, introduced a rubber covering for off-set rollers, consisting of rubber mounted on canvas, the margins of the canvas being without rubber,

so that they could be more easily clamped for adjusting the whole covering to assist in registering colours.

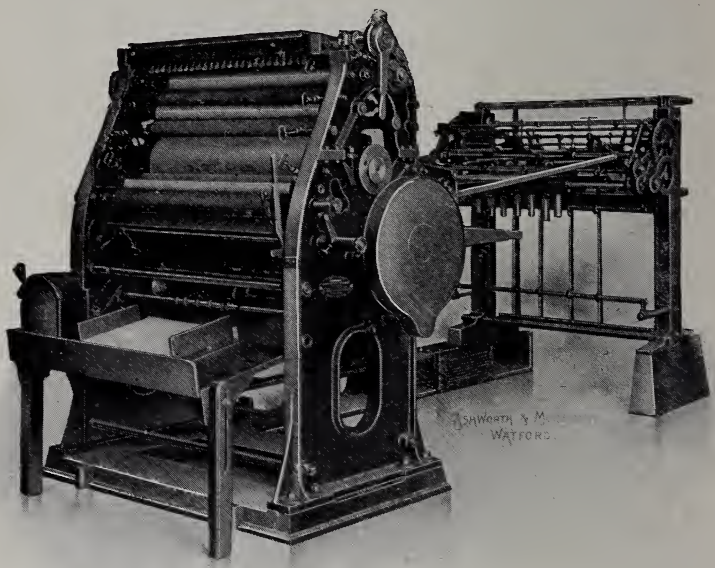
All this time the English makers had been slowly moving forward. Rubel had come to England in 1907, and installed a machine in London, which afterwards went to a large country house. The G. Mann Company brought their off-set machine almost to perfection early in the same year. Then Rubel and Sears jointly continued to make off-set rotaries, followed by the partnership of Sears and Nuttall in Bury, after the death of the much-lamented Ira W. Rubel, on September 5, 1908, aged forty-eight.



The Rutherford Off-set Rotary.
(By permission of A. Penrose & Co.)

All these off-set machines are a compound of the ordinary plate rotary and the tinplate printing machine. They possess such qualifications that they need little recommendation. The difference of working them is so small, and the economy of time and material so evident that any firm having large quantities of work can easily instal them to advantage. The adjustments are so fine that any kind of paper, thick, thin, rough or smooth, can be printed dry. The amount of ink is often reduced to

nearly one half of that used in direct printing machines ; and the work, whether in black only or in colours, can be as well, if not better, produced from them than any other form of lithographic machine. One feature of the use of the rubber off-set is the much greater facility with which photo-mechanical originals can be produced, including fine half-tone blocks.



Off-set Rotary of Sears & Nuttall. 1908.
(By permission of A. Penrose & Co.)

Concurrently with the introduction of this novel machine, the Aluminium Press Co. improved the gearing for throwing the cylinders out of contact in rotary machines, and special contrivances for radially adjusting the plate on the cylinder. The Linotype Co. added improvements for throwing the inkers out of contact and for a positive delivery, whilst they also added detector devices to rotaries to stop the cylinder in the event of

the cylinders commencing to run when no paper had been fed in (1907).

In 1906 should be noticed the multi-colour or multi-impression rotary made by C. Bull, Upper Montclair, New Jersey, U.S.A., in which, by suitable grippers on both cylinders, the small impression cylinder was capable of obtaining impressions from several successive printing plates on the large printing cylinder.

In 1907 H. S. Stark, of Johannesburg, South Africa, added rollers to a multi-colour rotary, which would dust the impressions with talc before they proceeded to receive another colour.

This summary of the history of rotary and off-set machines would be incomplete without a reference to the wonderful machine used in Russia, and introduced into London shortly after the patent of 1897 by J. Orloff. Although not actually used for either zinc or aluminium plate printing, yet its principles as a rotary off-set multi-colour simultaneous printing machine were almost as applicable to them as to blocks. Curiously enough Heppler, in Germany, made a machine to do similar work in 1898, but its complicated method of "transfer" would scarcely be accepted as satisfactory. In both machines each colour plate was separately inked. Each colour plate transferred its impression through rollers, until at last the rollers transferred them in superimposed position upon one printing surface (metal or stone) from which the print was taken.

CHAPTER XX.

Historical Summary of the use of Metals as Printing Surfaces, and the Patents taken thereon.

1801. *2,518.* SENEFELDER, JOHN ALOYSIUS.
For use of metal plates [especially zinc]. After the drawing was made it was etched with "hepar sulphuris water," a thin film of it being left on the plate. The damping water for printing was: Water 120, gum arabic 4, potash 15 to 20.

1844. *10,219.* BALDERMUS, of Berlin.
Etch drawing on zinc with gum and phosphatic acid. Wash clean and "scrape" the whole of the work, then rub it up with litho ink and gum water. Wash, roll up and treat with "Dulong's 'phosphatic acid,' or as termed by Davy a mixture of phosphorous and phosphoric acids mixed with gum water." If the etching be continued it produces a printing surface "similar to a stereotype." He formulated the idea of anastatic printing.

1852. *1,061.* D'HOMME, PHILIPPE, Manufacturer, of Paris.
First etch for drawings: Gall nuts 6, water 100—boiled down to 60. Gum tragacanth sol. 10 parts, nitric acid 10, alum 15, and hydrochloric acid 5. Between each impression damp with the same solution diluted.

1852. *1,109.* DURANDEAU, JEAN, of Paris.
After writing, engraving, or lithographing the design on the plate, pass it through a laminating press, when the impression is transferred, or rather indented, on the paper.

1883. *2,836.* MÖLLER, P. C., of Leipzig.
Coating plate with calcareous deposit; from carbonate of lime and addition of carbonic acid. This was the litho plate of C. & E. Layton.

1884. *14,967.* Möller, P. C.

Additions to lime solution (of above patent) of potassium silicate, carbonate of magnesia, aluminium hydrate, and graining the plate before coating.

1884. *16,884.* Dickes, W., Artist, 75 Loughborough Pk., S.W.

After drawing or transferring to zinc, roll up in strong ink, etch mildly, and apply to the plate dilute solution of a silicate [any silicate—potassium silicate, silicate of fluorine and ammonia, sodium silicate], or other substance, which will give to the plate a kindred property to litho stone, such as its power to absorb water.

1885. *4,816.* Josz, C. F., Bockenheim, nr. Frankfort, A/M.

Grained zinc plate, placed in solution of alkaline earth [calcium carbonate], dried, treated with watery (100) solution of alabaster (10) [gypsum, calcium sulphate, plaster of paris] and alum (5). The coating is dried and washed off with alcohol.

1885. *13,613.* Jaffé, Max, of Vienna.

The damping of the rollers and zinc plates with—nitric or hydrochloric acid, 2 to 4 parts; or sulphuric acid ½ to 2 parts, glycerine 30 to 50 parts; or gum arabic 7 to 10 parts, water 1,000 parts. For copper plates perchloride of iron instead of an acid, 2 to 5 parts.

1885. *3,305.* Wezel, J., of Wezel & Naumann, Rendnitz-Leipzig.

Preparation of zinc plates with calcareous coating. Make a mixture of litho-stone, chalk, marble, &c., and dissolve in sulphuric and hydrochloric acids. Add to solution a little asphalt dissolved in turpentine. Then add rosin or oil soap and thereby precipitate resinous or fatty acid compounds of lime. Filter off the powdery precipitate and dry it. Mix this powder with sodium carbonate solution, and spray it on zinc plates. In a further patent (1891, *12,890*) a little aluminium palmitate was added with the asphalt.

[This was the basis of the metalographic plates, or zinco-lith plate of Stroeger.]

1887. *6,353.* Wezel, J.

A machine for spraying the composition on the plate.

1887. *6,170.* Schmiel, E. O., Gohlis-Leipzig.

Cleaning and re-preparing stone and zinc. Treat with

benzine and follow with acid to remove the work. Cover with strong solution of magnesium chloride, containing 5 to 10% sodium silicate; dry for 5 to 20 minutes for stone, or 1 to 2 days for zinc. Rub the stone or zinc with pumice powder. Proceed to pumice the stone with water and magnesium carbonate. For zinc, use magnesium carbonate with solution of zinc chloride, and rub well in with pumice.

1887. *10,130.* SCHOEMBS, H., of Offenbach.

To clean zinc plates after graining, treat with mixture of nitric and sulphuric acids for a few minutes; rinse well with water and treat with ammonium salt solution—not ammonium sulphate. Before using wash well with water.

1887. *14,536.* BLOCK, G. H., of Penge.

Part of the patent dealt with preparing zinc plate by treating with: Alum, 2 lbs.; water, $4\frac{1}{2}$ gallons (720 lbs.); nitric acid about $3\frac{1}{2}$ lbs. ($2\frac{4}{5}$ pints), "in order to oxidize the surface of the plate."

[Alum dissolved in hot water, acid added, plate placed in bath and rocked, when a thin film is deposited on the plate.]

1887. *17,162.* SALCHER & SCHWERTSCHLAG, of Harland, Lr. Austria.

Roughen zinc plates in nitric acid bath. Coat with slaked lime, dry, brush well. Before use wash with strong alum solution. For etching use: Nitric acid, 2; gum solution, 10; water, 15. To clean the plate for corrections use: Alum, 4; acetic acid, 1; water, 400.

1888. *9,244.* MILLS, J. L., Art Colour Printer, Baldwin's Gardens, London.

A method of engraving on stone and zinc by sand blast, using varnish or gum for all the stages for stopping out. A photograph on the plate may be used as the resist, assisted by varnish or gum if necessary. Stencils may be used and the sand blasting conducted through them.

1888. *10,295.* MILLS, J. L.

"An air brush." An instrument for engraving and mezzotinting whereby currents of compressed air or steam and sand can be controlled by the hand and utilized for engraving and mezzotinting.

1889. *6,413.* MILLS, J. L.

Further methods of producing engraved design on stone and zinc. More particularly as to various ways of putting on the "grounding" and using the stopping out medium; the engraving being by sand blasts.

1889. *10,885.* HARRIS, J. G., Providence, Rhode Island, U.S.A.

The making of a machine with a tray having a forward and backward traverse; the plate being placed in the tray and covered with balls and sand for graining the zinc plate.

[The early form of the graining machine, with balls and sand.]

1889. *12,130.* BROCKLEHURST, C. G. B., of Peel Causeway, Cheshire.

Preparation of zinc plate by cleaning with sulphuric acid. Immerse in bath of: Acetate of lead, about 1 oz.; nitric acid, about $\frac{1}{4}$ oz.; and water, about $\frac{1}{2}$ pint. Dry, and finally wash with dilute acetic acid to brighten the surface.

1890. *7,597.* KINDERMANN, O., of Lindenau, Leipzig.

Preparation of zinc plates after graining by sand blast by treating with a suitable mixture of: Chlorate of zinc, 100; tetrachloride of tin, 25; nitric 2, and hydrochloric acids 2; and water, 1,200.

[This was the basis of the Patent Zinc Plates of Hull, which Mr. G. H. Block improved, by adding ammonia.]

1891. *12,890.* WEZEL, JULIUS.

Refers to Specification *3,305,* 1885.

In place of the chalky material being mixed with rosin or soft soap, it is mixed with aluminium-palmitate and a small quantity of asphalt dissolved in oil of camphor. Free acid is neutralized by adding NaOH or KOH. The mass is pressed and filtered. The residue is then suspended in a weak solution of soda and "blown" on the warm plate. The mixture is: Chalk, 12; aluminium palmitate, 1·2; oil of camphor, 9·0; asphalt, 0·1. To neutralize use about $\frac{1}{2}$% alkali. The "claim" is for aluminium-palmitate, and oil of camphor.

1891. *15,189.* SHAW, H., 216 Southwark Bridge Rd., London.

To re-prepare zinc plates in a special printing machine without removal. The plates are ground by sand and water in a trough, then they are re-coated by putting in the trough: Zinc chlorate, 100; tin tetrachloride, 25; nitric acid, 2;

hydrochloric acid, 2; water, 1,200. [1890, *7,597*, KINDERMANN, O.—Chloride, 100; tin tetrachloride, 25; nitric acid, 2; hydrochloric acid, 2; water, 1,200.]

This invention was in the main a big rotary machine for printing from several reels of paper, with paper for the "covers" of the finished journal, and to cut and fold and deliver all in position. The zinc plate idea was to adapt it for lithography so as to make it a complete invention.

1891. *15,238*. MULLALY & BULLOCK, of New York.

The use of aluminium plate, or aluminium electro deposited upon a metal in place of stone or zinc.

[This is the first patent of aluminium as a printing surface.]

1892. *10,781*. MULLALY & BULLOCK, of New York.

As to rolling or otherwise compressing the aluminium plate, to obtain a coarser or finer plate to suit various purposes.

1892. *12,688*. BITTNER, H., 24 rue de l'Evêque, Brussels.

Preparation of any metal, preferably an alloy of $\frac{2}{5}$ tin and $\frac{3}{5}$ zinc. The plate is scoured, then immersed in a bath of: [any] Silicate, 335; albumen, 12; water, 1,000. Then immerse in: Nitrate of lime, 2; water, 100. Then wash, and immerse in: Lime water, 1,000, to which sulphuric, 3 to 15, and phosphoric, 2 to 10, acids have been added. Finally wash and dry.

1892. *16,312*. STRECKER, O. C., of Mainz.

Treatment of aluminium plates. Plates to be ground smooth. After drawing or transferring, the plate is treated ["etched"] with gum, 10; an organic acid (*e.g.*, gallic acid, 3) and orthophosphoric acid [H_3PO_4] 1 of 20% solution. In place of the phosphoric acid may be used: metaphosphoric [HPO_3], pyrophosphoric [$H_4P_2O_7$], or hydrofluoric acid [HF]. This acts on the aluminium to produce a grease resisting surface. If the plate be treated with this solution before drawing or transferring on, it must be re-prepared with alum or acetic acid, and subsequently treated with a stronger solution of the same afterwards, such as gum, 10; gallic acid, 4; orthophosphoric acid, 2, of 20% solution.)

1892. *21,814*. HAGGENMULLER, F. F., of New York.

Embossing of zinc, type metal, aluminium, &c., celluloid, glass, &c., with a rounded stipple for drawing upon.

1893. *8,800.* FORREST (litho printer) and BUCHOLZ (compositor) of London.

Zinc plates rolled through cold rollers, placed in nitric acid 1, to water 100. Scour well with pumice and water. Repeat. Grain by sand blast, immerse in: Nitric acid, 4; phosphoric acid, 1; water, 500. Wash well with water and immerse once or twice more. Finally wash well and treat with weak alum solution. For plates requiring fine grain use, instead of above, sulphuric acid, 1; water, 100. Wash and finish with weak alum solution.

1894. *595.* BLOCK, G. H., of Hull.

Treat cleaned zinc plates with nitric acid 1 quart, alum 3 lbs., and water 50 quarts, in a bath; well rub with sponge or flannel. Repeat the treatment, and finally rub well with carbonate of magnesia; wash, and dry for use.

1894. *2907.* BLOCK, G. H., of London.

A method of producing a grain, stipple, or line pattern upon plate or stone by transferring or photographing it upon such surface, inking up and etching. Afterwards remove or erase the ink by alkaline or other suitable compound. The surface was then prepared as in the patent *595*, 1894, and was ready to be drawn upon, the resultant drawing being "grained" according to the grain produced.

1894. *4,779.* BEAL, E. T., of Hull.

After graining, immerse zinc plate in: Alum, 8 lbs.; nitrous acid, 4 lbs.; oxide or chloride of calcium, ½ lb.; sulphate of zinc, ½ lb.; water, 2 galls. [20 lbs.] Wash and remove dark film with sponge. Repeat treatment. Finally wash and dry.

1894. *22,415.* INCH, P., Washington, U.S.A.

For printing plates use an alloy of tin and zinc, with or without aluminium. Add some sal ammoniac [amm. chloride] to molten mass.

1895. *9,004.* NOAD, J. H., of East Ham.

Use of two metals together, one of which will alloy with mercury and the other will not. Thus iron may be covered by a deposit of copper; the design may be etched through the copper to entirely remove it and leave the iron bare. The copper may be treated with mercury, and it will then repel printing ink, whilst the bare iron will take the ink. Th e

design may be transferred on the plate or cylinder, with ink and paper which are themselves resists and non-resists, so that etching may be done at once.

1895. *18,876.* STRECKER, O. C., of Mainz.

Treatment of aluminium, zinc or other metal with cupric chloride, or other suitable salt. After etching treat with nitric acid and water if necessary; wash and dry with hard brush and talc as in Specification 1892, No. *16,312.*

1896. *4,603.* SOCIETÉ ANONYME DES PLAQUES LITHOGRAPHIQUES, of Brussels.

Cleaned and grained metal plates are washed and dried; during drying apply a coat of: Zinc white, 1; water, 360; silicate of potash, 26. The film left is smoothed by damping and brushing. A stone composition is then applied consisting of: Powdered litho stone, 150 ozs.; bicarbonate of soda, 45 ozs.; silicate of potash, 13 ozs.; albumen, 13 ozs.; chloride of iron, $7\frac{1}{2}$ ozs.; water, 10,000 ozs. Poured on the plate, warmed from below. Litho ink or crayon work can be washed off the plate with a mixture of benzine 9, and sulphuric ether 1.

1896. *15,699.* DUNCEAU, G., of Toulouse.

For printing plates use an alloy of aluminium, tin and zinc, with or without copper.

1896. *23,181.* CORNWALL PRINTING PRESS CO., New York.

To prepare aluminium plates: Remove the outer skin of the metal by graining with either coarse or fine sand or pumice powder; immerse in bath of alkaline solution, preferably caustic potash, then, after rinsing, immerse in bath of strong nitric and hydrofluoric acids, or nitric and hydrochloric acids, or nitric and sulphuric acid. Rinse well and dry for use.

1896 [1883]. *26,193.* CASANOVA, A., of Paris.

Preparation of metal plates for printing. Coat zinc plate by electrolysis with nickel in an alkaline bath of sulphate of nickel. The bath may be ammoniacal sulphate of nickel, liquor ammonia and water. Copper, brass and iron may be similarly treated.

1896. *28,460.* DELAZE, C., 74 rue Amelot, Paris.

Coating zinc plates by a spray machine. The coating paste consists of a particular kind of limestone, broken

and mixed with hydrochloric acid, oleic acid and vaseline or petroleum, then boil for several hours. The paste is washed, dried and filtered. For spraying upon metal plates the paste is mixed with silicate of potash; to the mixture is added carbonate of potash to neutralize the acid. The specification also describes a special machine for spraying.

For spraying on plates for litho: 15 kilos dried paste, dissolved in 60 litres H_2O; add 250 grammes silicate of potash (36° B). After well stirring add 250 grammes bicarbonate of soda. Such paste is ready for spraying.

The mixture to be: Sand or broken stone, 15 kilos; oleic acid, vaseline or paraffin oil, 16 centilitres; HCl, 3 litres.

The stone used is from Vigan in France; near Fünfkirchen in Hungary; in Bavaria.

The composition of the "natural limestone" should be:—

Carbonate of lime	96·39
Oxide of iron	·13
,, aluminium	·90
Silica	1·09
Carbonate of magnesia	·82
Water and organic matter	·67
	100·00

1897. *7,981.* PITT, S., of Sutton, Surrey.

Coating metal or other plates. The paste made by boiling crushed litho stone, 10 kilos, with sulphuric acid, 2 litres, to expel the CO_2, and adding thereto a mixture of hydrochloric acid, 2 litres; solid perchloride of iron, 50 grammes; and chloride of manganese, 50 grammes. The paste is well washed with water until neutral, then filtered and pressed. To use it, first mix into it a solution of bicarbonate of soda, then add a mixture of albumen, 130 grammes; glue, 70; and silicate of potash, 544 grammes; finally, add a solution of perchloride of iron, 275 grammes. The plates to be coated are cleaned with hydrochloric acid, washed and grained. They are then washed and scoured with hydrochloric acid, and treated with solution of bicarbonate of soda to neutralize the acid. The plates are placed on a vessel heated by steam to 160° C, and the liquid paste is sprayed on in successive thin layers, each layer being washed and brushed after application. To produce white plates, coat the zinc with a

mixture of zinc white, 86 grammes; potassium silicate, 1,100 grammes; albumen, 65 grammes; and water, 30 litres.

1897. *17,647.* SCHOLZ, C., of Mainz.

Aluminium plates after graining are submitted to rolling to flatten down the sharp points of the grain.

1898. *27,186.* WEZEL, J., 17 Dresdnerstr., Leipzig.

Relates to Specification *3,305,* 1885, and reference is made to Specification *12,890,* 1891. The zinc plate after graining is cleaned and immersed in aqueous solution of bicarbonate of potash; or may be coated electrically in the same solution, thus forming a layer of carbonate of zinc. The plate is then sprayed with a mixture of weak solution of soda, added to a thick paste made of limestone, 24 kilos., and aluminium, 250 grammes; with hydrochloric, 3 kilos., and sulphuric acids, 3 kilos. Chloride of iron may be added to give a yellow tone.

1899. *2,472.* HILDYARD, G. R.

Having transferred or drawn upon a zinc plate, it is properly etched and rolled. Dust well with resist and give the plate a moderate etch. After rolling up again, proceed to roll the plate in with lithographic varnish. It may be poured on or dabbed in. Before it dries, etch with water, 80; nitric acid, 4. Etch several times, increasing the strength each time. The result is a relief block, which can be printed in a letterpress machine. This was the basis of the "Wharfe Litho" process.

1899. *10,049.* BLOCK, G. H., 9 May Street, Hull.

Metal plates, after graining and cleaning, may be immersed in solution of aluminium sulphate, 750 grammes, with nitric acid 1 litre, and water 10 litres, and passing an electric current through the bath. Finally rub the surface with a paste made of magnesium carbonate, methylated spirit and water. Instead of the above bath, it may be for aluminium plates, acid sulphate of aluminium, potash alum, nitric and phosphoric acids and water. The immersion in the bath should be repeated.

1900. *6,701.* STRECKER, O. C., 26/28 Christophstr. Köln.

A method of depositing by electricity upon any metal used for printing, a layer which is absorbent of water and repellent

of ink. The solution in the bath may be ammonium bi-phosphate, or ammonium silico fluoride. When complex salts are used it is advisable to add ammonium nitrate, tartaric (or other organic) acid, and gum arabic. The deposit may be made in a bath, or by using a rubber connected to a current, with the solution on the plate, and gently rub it over the plate.

1901. *6,307.* VANDYKE, F. R., of London.

"Vandyke Process." Method of copying original drawings or tracings by photographically printing through them upon sensitized stone or metal. The sensitizing film is: Fish glue, 1 oz.; soft gelatine, 60 grns.; ammonium bichromate, 45 grns.; water, 12 ozs. The film is put on whilst the plate is damp, and spread in a whirler. Dry in a dark oven. Expose under original drawing. Stain with aniline dye. Develop with cold water and gently rub with cotton wool. Clean the plate well. Cover with a strong transfer ink combined with asphalt and thinned with turps, *e.g.*, litho writing ink 2, bitumen 2. Immerse in weak hydrochloric acid bath and gently rub off all the remaining film. Wash well and rub with carbonate of magnesia. Proceed to etch and roll up as for original drawing on zinc.

1901. *14,993.* TOOBE, H. L. B., of Hornsea, Yorks.

Zinc or aluminium plates; aluminium and bronze; polished plates treated with solution of nitroso-nitric oxide, then with distilled water, 1 gall.; zinc or ammonium sulphate, 1 lb.; calcium oxide, 1 lb.; sulphate of ammonium and aluminium, 1 lb.; nitroso-nitric oxide, 2 lbs.; and hydrofluoric acid, $\frac{1}{10}$ lb. Graining by sand blast before above baths. Etching solution of phosphoric acid, chromic acid, tannic acid, carbolic acid solution and water. To clean work off, wash out with turps and treat with potassium oxide and water.

[This is apparently the basis of the "Noliston Plate."]

1902. *2,234.* STRECKER, O. C.

Grained plates, preferably zinc, to be treated after the design is rolled up, with solution of, such as ammonium silico fluoride, or ammonium acid phosphate, with gum arabic, and an oxidizing agent, such as ammonium nitrate, thus producing a hygroscopic salt adherent to the zinc, almost insoluble in water.

1902. *3,608.* KLIMSCH & Co., Frankfort-a-Main.

A variation of "Vandyke Process," the particular point being cleaning the plate after development to receive the asphalt transfer ink. For aluminium, use weak nitric acid For zinc, use a bisulphite. It is pointed out that acetic, citric, tartaric, and other organic acids are too strong. The patent includes the interposition of colour selection screens when the original is coloured and one colour only is required on the plate. Also the intervention of a screen plate if necessary.

1902. *15,769.* GISEVIUS, B., of Berlin.

The application of the "Vandyke Process" to aluminium. First sensitive coating: Water, 200; double chromate of potassium, 7; syrupy solution of gum, 40 to 50. Dry in the dark. Expose under original drawing. Develop in cold water to remove unexposed film. Coat with 2nd sensitive film of: White of egg, 7; chromate of potassium. 54; water, 9,000; ammonia, 234. Leave exposed to light. Roll up or cover with an asphalt transfer ink. Develop in hydrochloric acid 2, water 4. Finally treat as original on aluminium.

1902. *19,007.* CHRISTIE, G. S., Rocky Mount, Carlton, Nottingham.

Preparation of a printing surface for cylinder printing surfaces as in rotaries, or as an endless band for wall papers. A suitable length of fabric is coated with a mixture of: Magnesium chlorate, 10; potassium borate, 100; glycerine, 10; water, 10, mixed to a stiff paste. Add calcium carbonate, 30; potassium or magnesium carbonate, 15; manganese borate, 3; burnt sienna, 3; oxalic acid, 1; hydrate of lime, 1. When well mixed it is ground finely, passed through a fine sieve, coated upon the fabric, and dried at 50° to 60° C.

1903. *6,155.* BOWER, G., of St. Neots, and GAUNTLETT, F. W., 2 Tower Royal, Cannon Street, E.C.

Iron or steel plates, coated with magnetic oxide of iron; or coated with copper or other metals and then oxidized. To give whiteness coat with either zinc, tin, or both, before oxidizing some other metal on. In oxidizing, steam enters the retort and passes up amongst iron turnings. Oil or combustible gas is passed in with the steam.

1903. *7,165.* CORNWALL, G. R., Rye, New York.
A method of building up a whole printing surface of bars, to assist in making corrections. Aluminium or zinc, solid or in plates, is used.

1904. *10,855.* SEARS, F. W., of New Zealand and London.
The "High Light" process. The method of taking a negative of a subject and photographing it to make a screened positive. Such positive may be used for intaglio photo-engraving; or for making a contact negative for photo printing on zinc or aluminium.

1904. *4,345.* HARRAP & CRAWFORD, of London.
The application of an analogous process of "photo stone" to aluminium only. The subject is photographed and converted into a collotype printing plate upon aluminium. From it the transfers for the whole set of colours are made on aluminium by direct transfer. The colours are then worked up by a draughtsman by additions in ink, or erasures by a corrosive, such as sulphuric acid, caustic soda or potash, creosote or its derivatives, oxalic acid or its acid compounds, the special feature being the speed and ease of production of chromo work in a fine photographic grain which can be printed in the machine, and the reduction in the number of colour plates used.

1904. WHIPPEY, F. C., of Indianapolis.
A method of enlarging half-tone pictures by transmitting a strong light by condensers through the negative, thence through a camera, on to sensitized metal.

1904. *19,385.* BOWER, A. S., Avenue Road, St. Neots.
Additions to Specification *6,155*, 1903. Graining the plates. Forming sulphides, chlorides, phosphides, iodides, fluorides on the iron. Forming carbonate or oxycarbonate on lead, after it has been coated on iron or brass.

1904. *21,322.* STRECKER, O. C., 11 Klappacher Str., Darmstadt, Chemist, and STRECKER, H.
The electrolytic production of deeply-etched zincographs and relief etchings for lithographic printing from commercial zinc plates. Place the zinc in bath of zinc acetate, formate or other salt. Make the design plate the anode, and put in

another zinc plate as the cathode; use a current of at least 2 amps. per sq. decimètre of one-sided metallic anode.

1904. *28,392.* Swan, J. W., and Swan, D. Cameron, London. The application of printing from intaglio plates in flat-bed or rotary machines. The intaglio plate is prepared from a "screened" positive of the photogravure type. The sensitive film is bichromated albumen, or gum or gelatine. After exposure it is rolled up in lithographic ink, developed and gummed. Roll up in stiff ink, and dust with good resist. Etch with nitric acid, and wash clean. The zinc under unexposed parts is thereby left clean. Dust again with bitumen or the like, and warm until the resist melts. Immerse in caustic potash to remove all the remaining film. Gum up and dry. Wash out on dry gum with benzole or turpentine, to remove bitumen from the etched zinc. Fill in the work with good transfer ink. From such plate prints may be taken in lithographic hand press, machine or rotary.

1905. *19,970.* La Société Jullien et Dessolle, 58 bis, Rue Gide a Levallois-Perret, France.

Thin sheets of metal (copper), or several superimposed metals, prepared with an electrolytically deposited surface of a precious metal—e.g., silver, gold, &c.—to obtain a dull-grained surface. Treatment: Clean with alcohol; transfer as to stone; treat for two minutes with weak HNO_3 and $CaCO_3$ powder; wash off, gum up and dry; roll up with stiff ink; rosin and talc, and treat with "American potash"; gum up well. To clean a plate entirely from old work wash out with turps; wash clean; rub out the work with concentrated American potash and a little rotten stone; wash well; treat with dil. H_2SO_4; and finally a wash of potass. bichromate.

1906. *16,094.* Bull, C., Upper Montclair, Essex, New Jersey, U.S.A.

Zinc or other suitable printing metal has a design engraved, stamped, or etched upon it. The remaining surface is treated with a resist, and the design itself is filled up with electro-deposited iron, copper, or other metal capable of taking ink and repelling water. The deposited metal is then smoothed off level, and may be printed from.

1907. *25,710.* TUTZSCHKE, J. F., 4 Edward Street, Hampstead Road.

Method of finally etching zinc plates prior to printing. The work must be dusted with talc. The mixture is: Potassium phosphate, 2 oz.; potassium nitrate, 2 oz.; sodium phosphate, 1 oz.; sodium nitrate, 1 oz.; water, 1 gall. This solution is used without gum. It is left on the plate about two minutes, then washed off, gummed thinly and dried. Wash out on dry gum with turpentine; fan dry; wash off gum; roll up; dust with talc. Clean up the plate, and treat a second time with the special solution above. Before transferring, give a wash over with alum, 4 ozs; water, 1 gallon. For high relief, etch with alum, 4 ozs.; nitric acid, 4 ozs.; water, ½ gallon. He particularly claims the non-use of gum in the etch, as different to any ordinary zinc etching.

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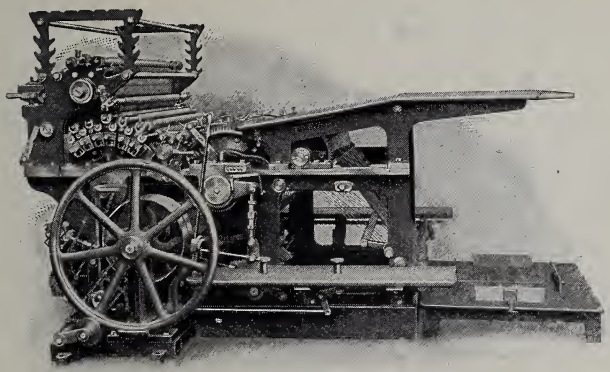

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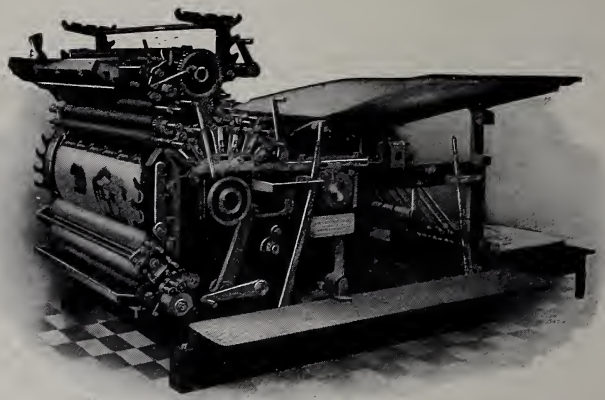

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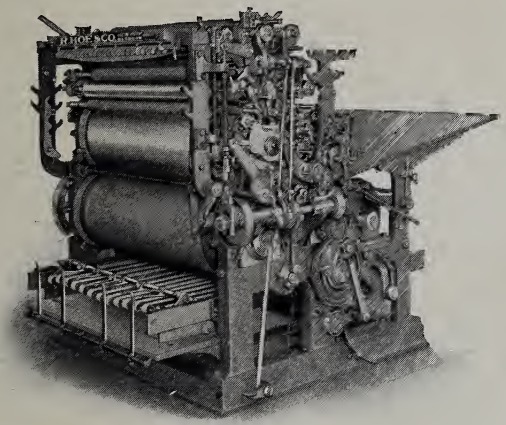

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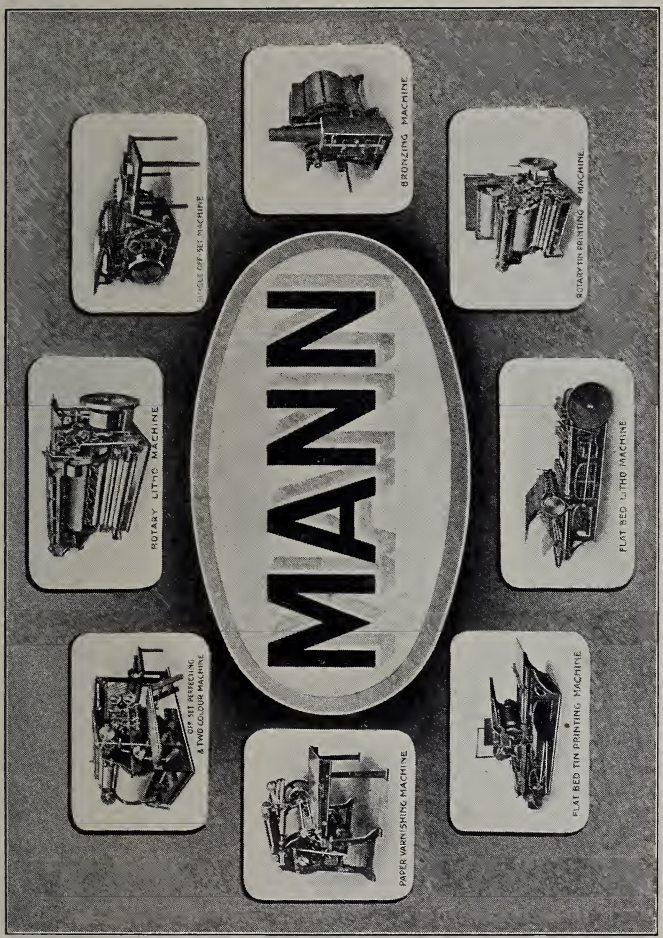
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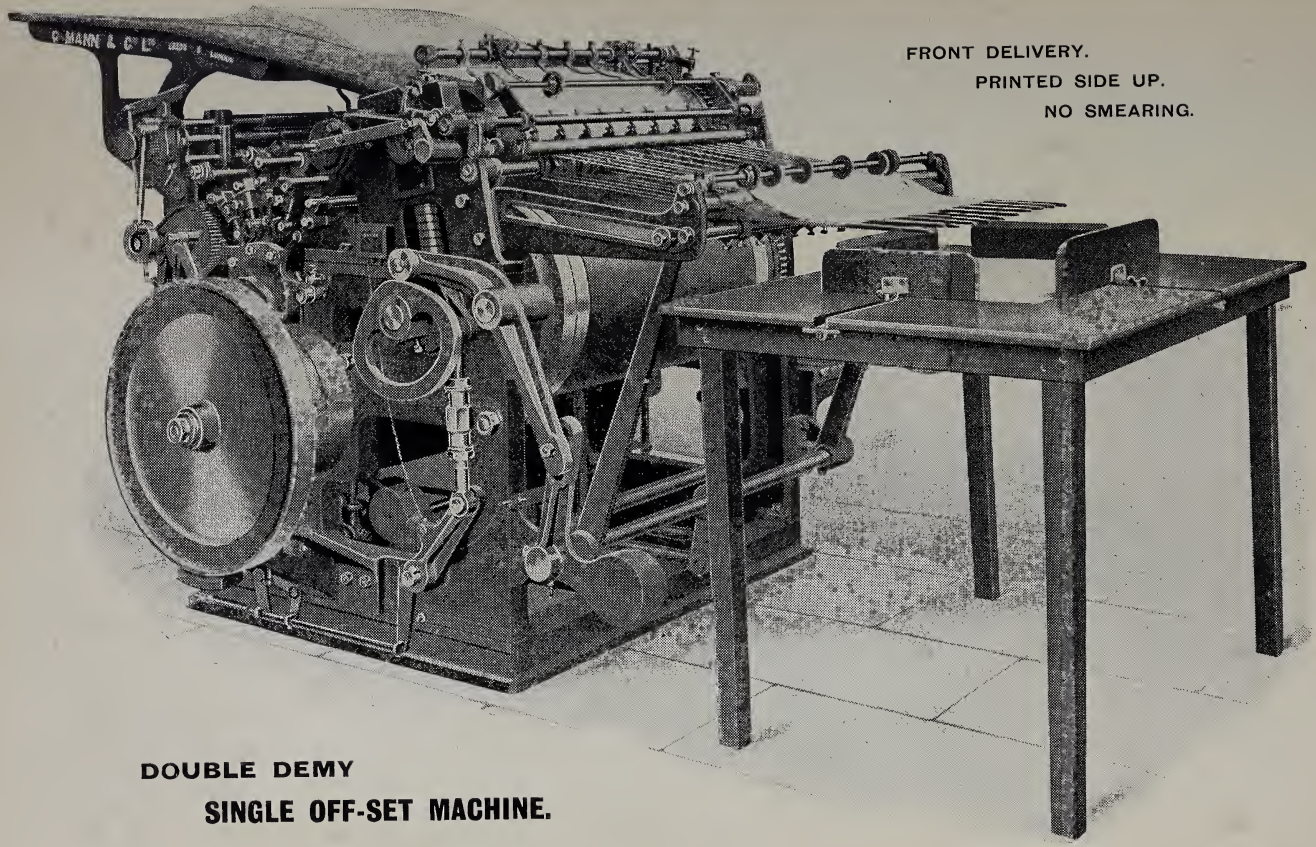

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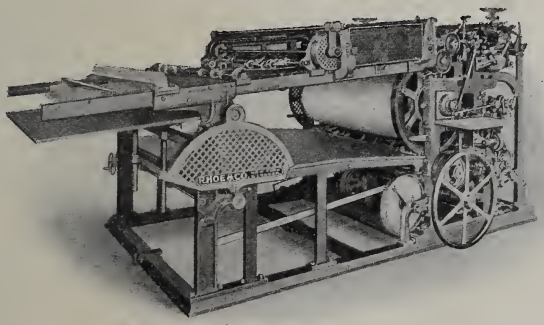

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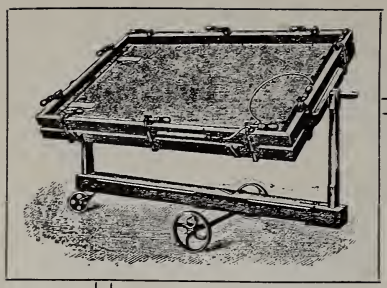

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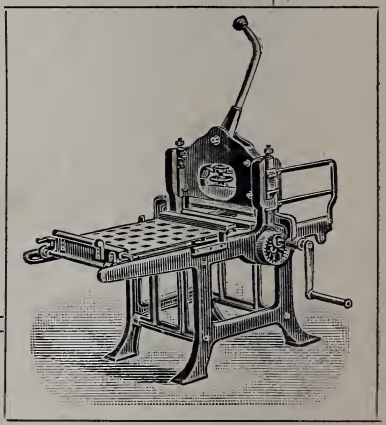

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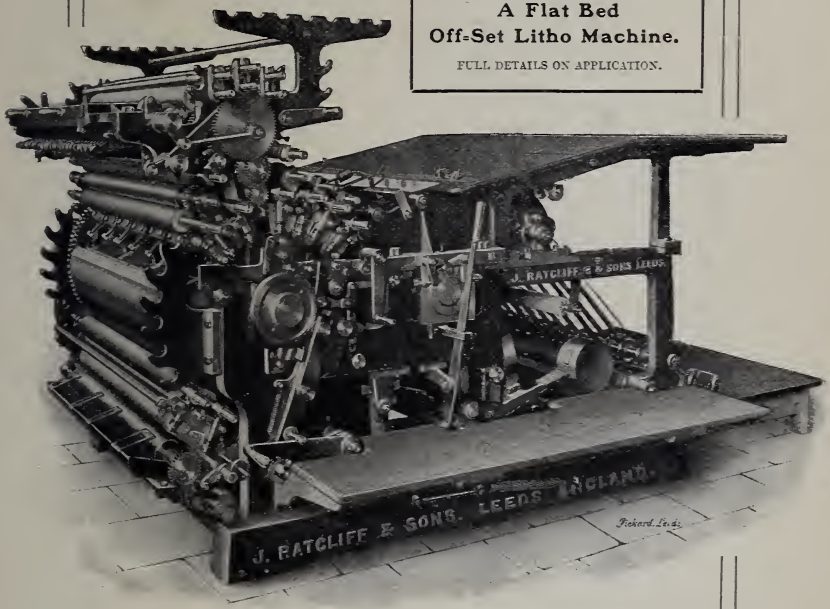

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